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Fig. 1—Tote-boxes of soft parts as they arrive at the hardening room. Fig. 2—Steel skids loaded with packed boxes ready for the furnaces

A Mechanically Equipped Hardening Room

By C. T. Willard

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Scientific control and automatic equipment reduce force and greatly improve results—Handling of small parts in large quantities—Special appliances for tool and cutter hardening

THE hardening room of the Singer Manufacturing Co., at Elizabethport, N. J., has been developed around the basic principle that a few exceptionally good men with mechanical equipment will turn out better and more uniform work than a larger number of hardeners of the old school. Under the old conditions work went into the hardening room with a prayer that it would come back in the desired condition but all too often the prayer was not answered. Too much depended on the individual skill of the hardeners and on variable conditions some of which were not under their control. As a result, a great deal of money was lost in spoiled material. Unfortunately the loss was not confined to the hardening room for many of the defects did not show up until the parts had passed through several other departments and had had a lot more work done on them, all of which was wasted.

Under the present arrangement there is a card file containing complete hardening specifications for each of over 20,000 items. As new parts are put into production specifications for them are worked out and added to the file. When a part comes over to be hardened the cards are consulted and a work ticket is made out giving details of the procedure to be followed. This ticket follows the work and serves as a perpetual inventory card. If there is no record in the file the part cannot move until specifications have been worked out and a ticket can be filled in.

Parts always travel through the hardening room in unit quantities. For instance, if a lot of 3,000 parts comes over from the machine department, perhaps 2,400 will be sent out from the office in standard unit quantities of 400 each and the balance will be held in stock for emergency demands. Remember that most of the parts that go to make up a sewing machine are quite small. They will vary in size from 50,000 to a handful up to a 1½-in. shaft 36 in. long.

Standard tote boxes which are used throughout the plant are shown in Fig. 1 as they arrive at the hardening room. The soft parts contained in them are packed during the day in the boxes shown in Fig. 2 which are in turn stacked on the metal skids illustrated ready to be taken to the hardening furnaces by a Cowan truck. After a stay in the oil-fired furnaces at

the specified temperature and for the specified length of time the boxes are withdrawn from the furnaces and shaken out over a sieve and the parts dumped into the quenching tank shown in Fig. 3. The hot boxes are put back on the metal skids and taken back to the loading station where they are left to cool.

As will be seen in Fig. 3, the quenching tank con-

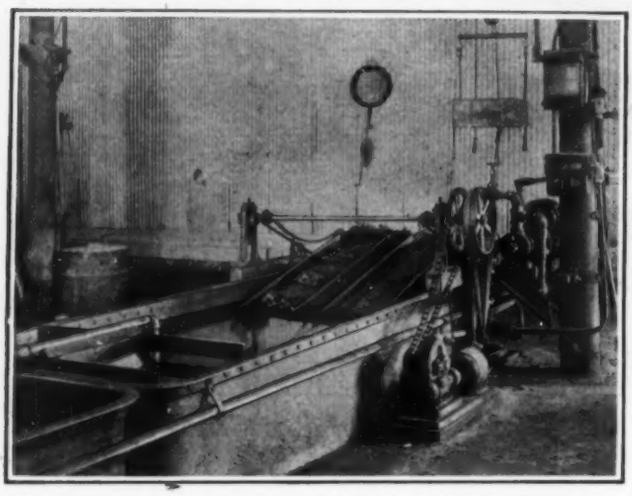


Fig. 3—Quenching tank equipped with belt conveyor

tains a submerged conveyor on which the cooled parts settle and are carried out, to be dropped into a basket, the oil draining off as they ride up on the belt. The basket is picked up by a small crane and taken to the soda washing tank. The particular arrangement used depends on the fact that the parts come through in relatively small quantities which must naturally be kept separate. Four different lots can be seen on the conveyor belt in the illustration.

A battery of automatically controlled rotary, gas-fired retorts used for gas carburizing and built by the American Gas Furnace Co. is shown in Fig. 4. The work is put into the retorts by means of the U-shaped scoops shown on the floor in the illustration and is raked out with the long-handled rake shown leaning against the quenching tank. It has been found desirable to facilitate the carburizing by introducing a carburizing compound into the retorts. To separate the parts from this compound they are raked out onto vibrating screens as shown and then slide down into the quenching tanks. In the tanks are perforated baskets one of which is shown hanging from the monorail crane which is used to transport them to the washing tanks.

Machine for Local Hardening

Several different machines have been devised for performing local hardening operations. The one illustrated in Fig. 5 is used in connection with a lead bath for the local hardening of the wings on the piece shown resting on the cover of the bath at *A*. Each of the five arms of the machine is loaded by hand as it indexes around. Only the wings of the piece are submerged in the molten lead as the arm comes around, the cycle of the machine providing for the desired duration of heating. As the arm rises from the lead the work is brought against a knockout and is dislodged over a chute that directs it into the basket in the quenching tank.

A six-arm machine for hardening the end of a part known as a "finger" is shown in Fig. 6. The heating element is a gas needle flame. Each piece is brought in front of the flame as the arms index and held there for a specified interval. The arms are loaded by hand and the pieces are knocked out by a trip that is operated by a pedal.

The automatic unit illustrated in Fig. 7 is used principally for hardening small springs and high-carbon steel pieces. Parts fed into the hopper are carried slowly through the rotating retort by the action of a screw cast on the inside of the retort. They are discharged at the other end upon a submerged conveyor belt on which they are carried through the quenching

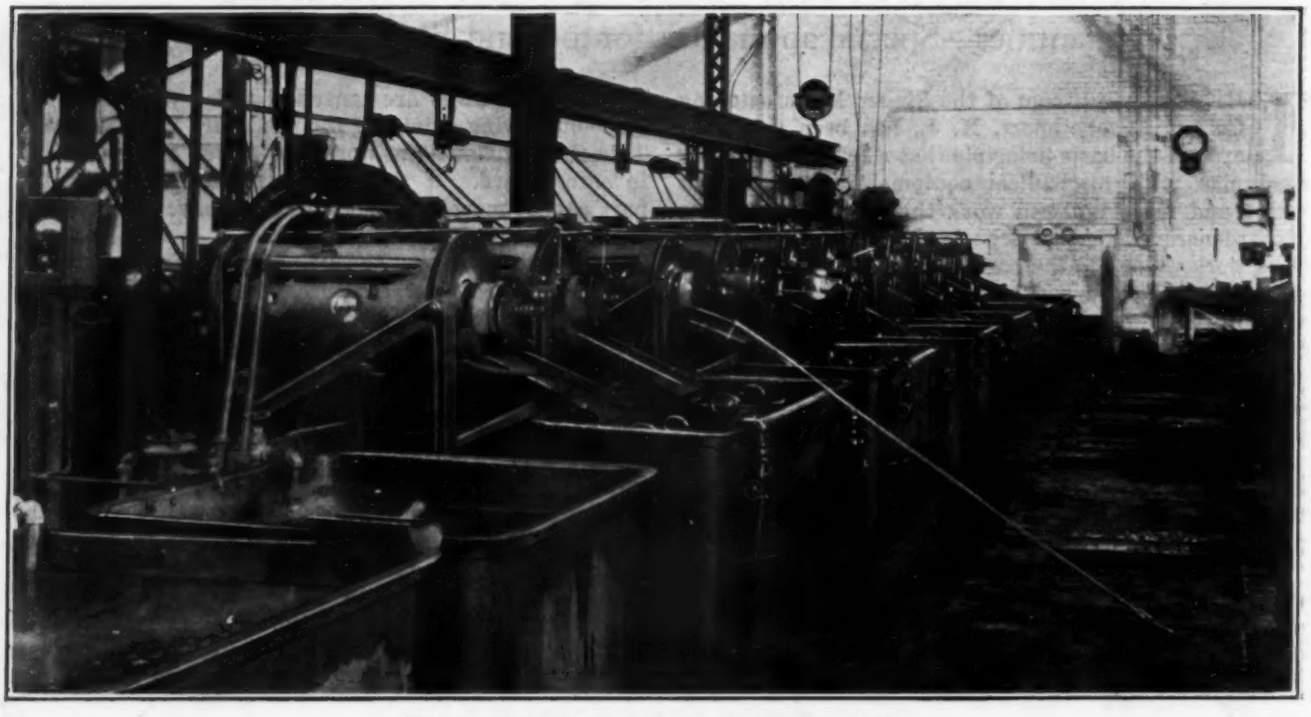
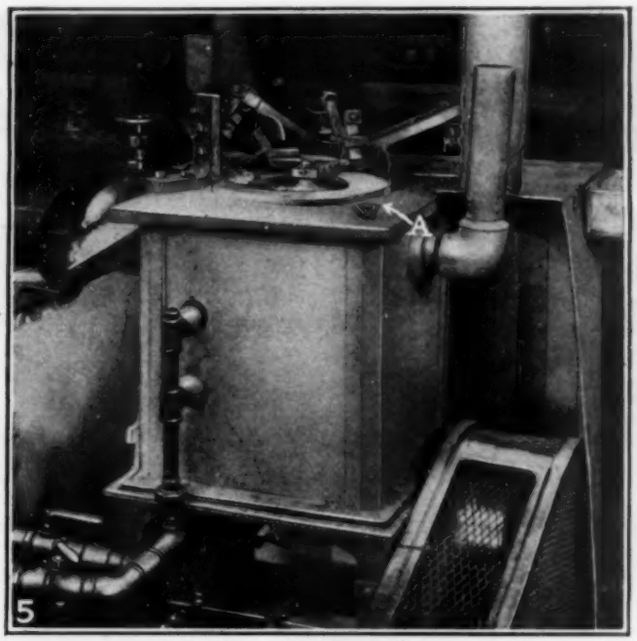


Fig. 4—A battery of gas carburizing retorts



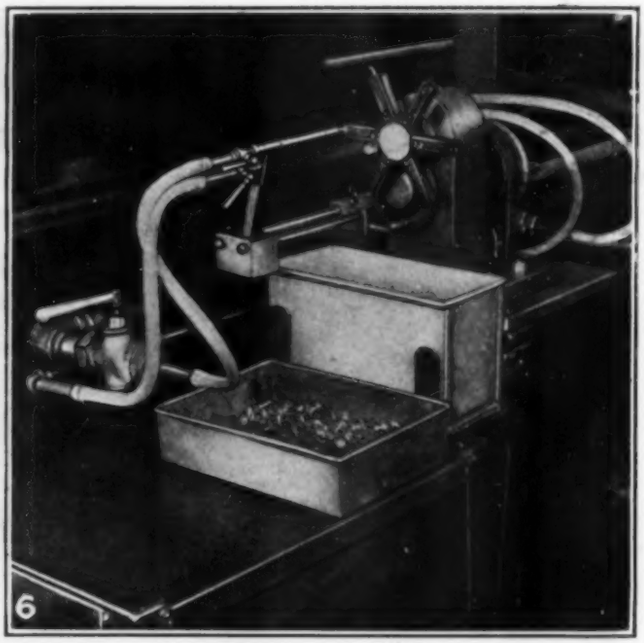


Fig. 5—Rotating fixture for local hardening in lead. Fig. 6—Indexing fixture for local hardening in a gas flame

medium and discharged into a basket as shown. The belt is fitted with cleats to keep the parts from sliding back into the tank. An automatic heat controller governs the temperature of the retort.

Another automatically controlled installation is shown in Fig. 8. The parts are fed by hopper with a moving bottom onto a reciprocating slab which extends from end to end of the furnace. The slab is moved forward 1 in. by the mechanism and brought up against a stop. As it hits the stop all the parts it carries slide forward a short distance and then rest until the jolt is repeated. The work is thus slid through the furnace

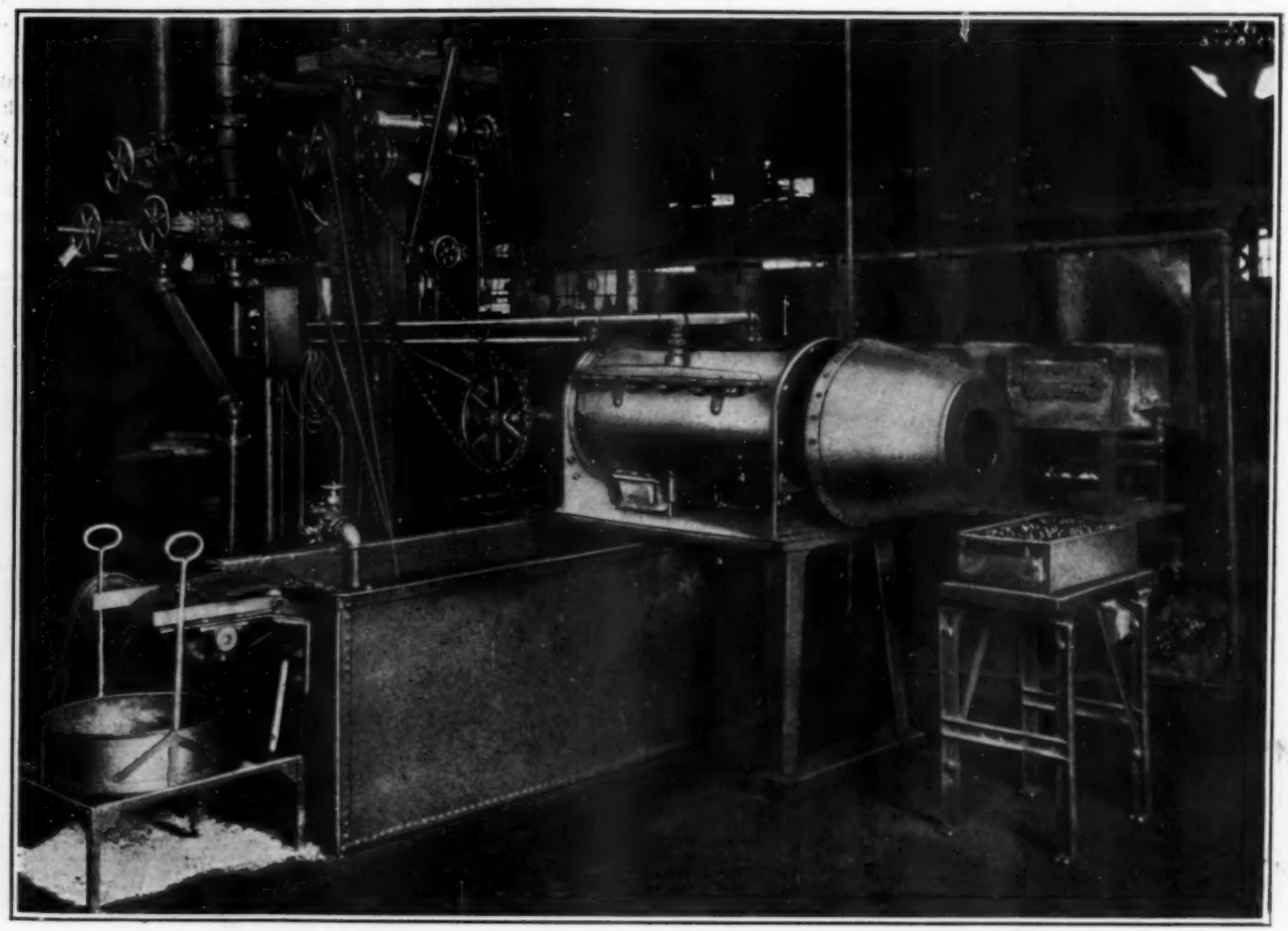


Fig. 7—Automatic unit for hardening small springs

Fig. 8—Automatic jolt-feed unit for hardening small parts

in a series of little jumps and discharges upon the submerged conveyor belt in a steady stream. The rest of the cycle is essentially the same as for the installation just described.

Installations for tempering operations are shown in Figs. 9 and 10. The hopper in Fig. 9 is shown filled with needle bars. They feed down onto the slots in the conveyor sections and are then carried past gas needle flames that heat only the projecting ends of the bars. The sectional conveyor only takes the work past the heating elements. It then discharges it onto the two roller chains to be seen at the left of the machine table. The length of these chains is such, and their rate of travel is so timed, that by the time a piece reaches the end of the table and drops into the container, the heated end has cooled sufficiently to obviate any possibility of further structural change due to the transfer of heat from pieces that may be in contact in the container.

A battery of tempering drums is shown in Fig. 10. The drums are shown, from left to right, in the working, loading and discharging positions, respectively. Three of the loading scoops are in the foreground of the illustration. The parts coming to the drums are hard and brittle and must be heated to develop the desirable qualities of a spring. The temperature

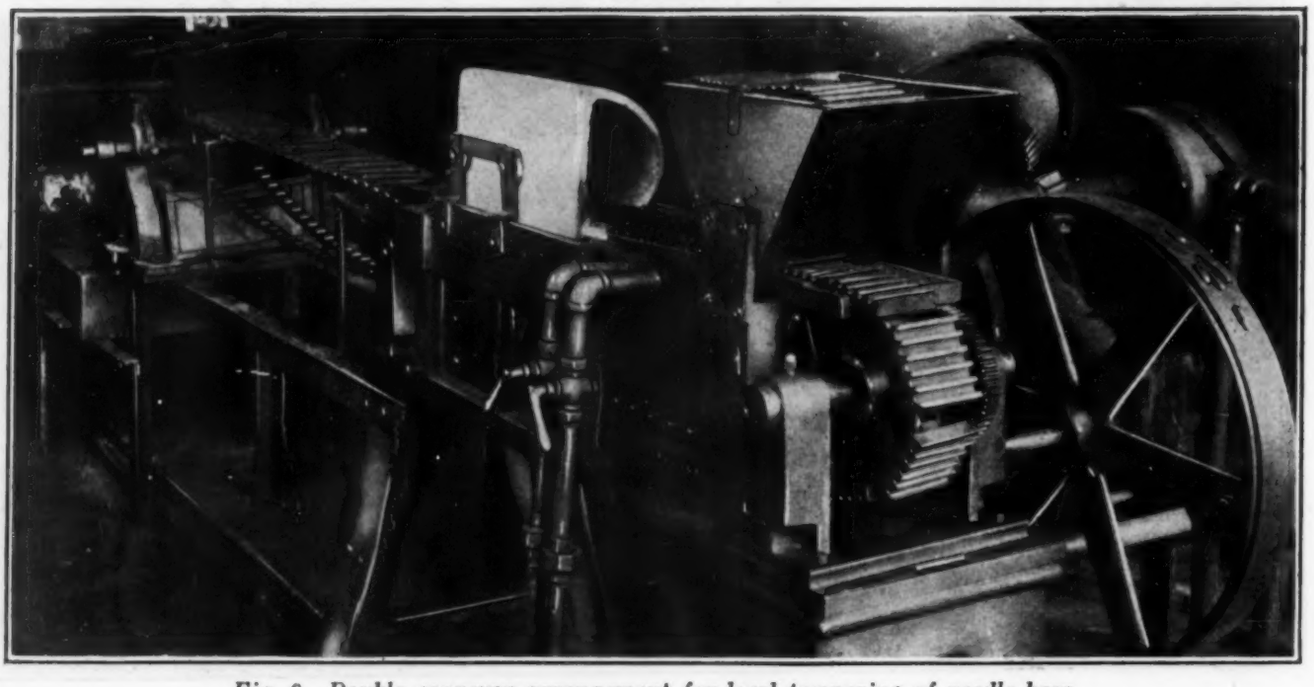


Fig. 9—Double conveyor arrangement for local tempering of needle bars

Fig. 10—A battery of tempering drums

and duration of the treatment depends, of course, on the material, its size and the previous treatment it has undergone.

In addition to what might be termed the production work of the Hardening Department, a large number of

Fig. 11—The tool hardening division

dies, cutters, reamers, special drills and other tools and some of the larger sewing machine parts are treated in the tool hardening division. A general view of a corner of this division is the subject of Fig. 11.

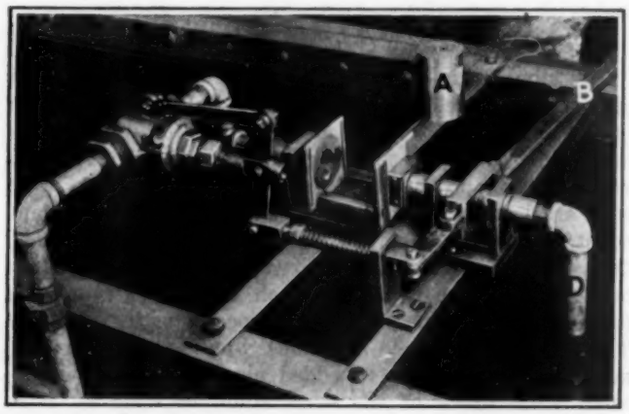


Fig. 12—A fixture for quenching the inside of a hollow cylinder

Two of the electric furnaces, a salt bath, the control apparatus and a number of typical parts are shown. The control apparatus consists of Leeds-Northrup recording potentiometers. High-speed steel is heated in special carborundum-lined gas-fired furnaces made by the American Gas Furnace Co. The Bellis lavite bath process is also used for high-speed steel.

The device shown in Fig. 12 is for quenching the steel surrounding the hole in a die like the one shown at *A*. Lever *B*, as it is pushed to the left to clamp the die between asbestos-faced jaws, opens the gate valve *C*, thus throwing a heavy stream of water through the hole in the die and out of the discharge pipe *D*. This is only one of many special quenching fixtures used for such purposes.

As stated at the beginning of this article, hardening specifications for all the parts used in Singer sewing machines are on file in the office of the Hardening Department. It sometimes becomes necessary to revise them as, for instance, when a machine designed for certain speeds and duty is applied by users to much heavier duty or higher speeds, or both. In such cases breakages and excessive wear are sure to result and investigations must be made to determine the reason for the failure and the steps necessary to prevent a recurrence.

All tools and gages are tested after hardening by either the Rockwell or Brinell methods. Generally speaking, the Rockwell test is indicated for routine testing of the harder parts while the Brinell test is preferred for use with the softer ones.

In the construction of the special hardening furnaces extensive use is made of Nichrome. Sad experiences with steel tubes 50 in. long that shortened 6 in. and contracted several inches in diameter, and with cast iron pieces that grew so much that they could not be withdrawn from the furnaces pointed out the economy of using the more expensive Nichrome alloy as a substance for furnace use.

Aligning a Line Shaft—Discussion

By H. K. Griggs

Owing to difficulty in obtaining wire of correct sizes to align a shaft as directed on page 162, Vol. 63 of the *American Machinist*, a common method is to use the couplings. If they are accurately turned and faced and the hangers are adjusted so that the outsides and faces match up perfectly the shafts will be in line. A steel scale can be used on the outside and feelers employed to check between the faces.

If there are no solid couplings the ends of the shafts should be butted together and a long straight-edge used on the top and sides. If the hangers are not in a favorable location the shaft should be supported temporarily with blocks and wedges. A spirit level with a grooved bottom can be tried every foot of length to detect sag.

In locating the hangers before placing the shafting in them, some millwrights use blocks of wood semicircular in section representing one half of the shaft. A center line is drawn on the flat side. By running a line along these blocks when in the boxes, with the caps removed accurate lateral adjustment can be obtained. Using a straight-edge long enough to reach two or more boxes enables the hangers to be leveled and vertical adjustments secured.

Welding with Tobin Bronze

BY I. H. CHANCEY* AND W. C. SWIFT†

ALTHOUGH the term "welding with Tobin bronze" is commonly used to describe the Tobin process, there is little similarity between it and the common process of welding with iron filler. In the case of iron filler, it is usual to carefully clean the weld areas of the job, but in the Tobin bronze process, the thorough cleaning of the weld areas is absolutely essential. In welding by the old process, the base materials are placed in position and if no preheating is required, the oxy-acetylene flame is applied directly on the weld areas which are brought to fusion heat as rapidly as possible, using the greatest heat of the flame and then similar material is added while the weld areas of each base material are maintained at fusion heat, until the joint is filled and the weld completed. In welding with Tobin bronze it is advisable for the operator to apply the heat a little back from the joint and to let it flow evenly to the entire surface of the "V," taking care that the weld areas are not heated above a dull red. A good flux should be used and in making a large Tobin bronze weld, the weld areas should be "tinned" with the Tobin bronze and bronze should also be added to complete the weld. It is essential that the inner cone of the oxy-acetylene flame be kept away from the Tobin bronze since it will burn quickly and weaken the weld.

THE PRINCIPLES ARE DIFFERENT

Welding with steel and cast iron is based on the principle of fusion of the weld areas with the filling material. Welding with Tobin bronze is based on the principle of surface alloying with a dissimilar material. The principles are different in every essential respect and the reason why so many welders have had no success is that they have tried to weld with Tobin bronze exactly as they weld with steel or cast iron.

It is probably a question with welders who have been using successfully the old process, why they should weld steel and cast iron with Tobin bronze. It is well-known that when malleable iron is once melted it is no longer malleable iron but only a very poor cast iron. The Tobin bronze system does not require melting, and so is advantageous in such a case as this one. In the case of the welding of cast-iron pipes in sizes above 4 in. in diameter, under the old process the pipes will crack without preheating, but the mild heat used in the Tobin bronze method is not sufficient to affect the pipes. Preheating is seldom necessary.

There are some welding shops which have, in the past three years, welded about 500 automobile engine blocks each with Tobin bronze with complete success, frequently doing the work without removing the block from the car. It is becoming the common thing in railroad repair shops to weld locomotive cylinders in place with Tobin bronze. Since this material is about three times as strong as cast iron, it is possible to use proportionately less of the bronze. Anything will break in the weak spot, so it will be advantageous to make that spot three times as strong as at first. Then, if the weld can be made without preheating and in one-third or less the usual time and still have a joint three times as strong and one that will not rust, why not weld with Tobin bronze?

When the subject of bronze welding was raised on the Georgia Railroad we decided to make some simple tests of the process for our own satisfaction. Two pieces of Tennessee Bloom iron, 4¼x4¼x12 in. long were welded together by the acetylene process, using ¼-in. Tobin bronze filler. This test piece was then placed in a wheel press and pressure brought to bear directly against the weld. The bar started bending at 75 tons pressure; bent 2 in. out of center at 100 tons pressure. At 100 tons, the pressure was released and reapplied on the other side. The bar started bending at about 100 tons, and at 125 tons pressure it bent 1¾ in. and cracked half way through the center of the weld.

In the same manner, a test was conducted with ¼-in. Norway iron filler. At about 70 tons pressure the bending began and the bar was 2 in. out of line at 100 tons. Upon a reverse pressure of 95 tons, the bending began again and at 110 tons pressure it bent 1⅛ in. out of center and cracked halfway through.

A bar welded with No. 1 patented steel ¼-in. filler began bending at 80 tons pressure, bent 1¼ in. out of center and broke clear through the center of the weld at 100 tons pressure.

A bar that was electrically welded with ⅜-in. filler started bending at 85 tons pressure, bent 1¼ in. out of line and fell in two pieces at 100 tons pressure. These tests showed that the bronze weld surpasses the other by a margin of fifteen tons.

It was found that the bronze weld contracted only ⅛ in. after entirely cooling off, eliminating the frame problem with which railroads are forced to deal. Features in favor of the bronze weld are that the process can be completed in about one-half the time required for the old process and at one-third less expense. One example may be taken from our welding of the top rail of an engine in front of a main driver without removing anything and with no allowance for expansion. This job was completed within thirty minutes after the torch, which used No. 10 tips, was applied. The entire cost of this operation, on a frame 4x5 in. in size, was approximately 10 dollars.

Steel can be welded with bronze in about one-half to one-quarter the time required to make a weld with steel. The bronze weld is as strong as the steel weld, there is no injury to the base material, and there is little if any warping or pulling out of line. In welding galvanized iron, the welds are made very rapidly, with no burning of the galvanized coating, without rust, and with practically no corrosion.

ONLY ONE EXCEPTION

To summarize—practically every article or part brought to a welding shop can be welded with Tobin bronze, with the exception of those of aluminum. In a large central city a new repair shop was opened last year by a man who still does not know how to weld with steel or cast iron, but he bought an oxy-acetylene outfit and started out in business using bronze filler. Occasionally he has to turn away a job, but he turns out two or three times as much work in a month as the welders who use the iron process do in a month. There are many welding shops who began with oxy-acetylene and who later added electric welding equipment since much of the work could be done by it in place and without preheating. Most of this class of work can be handled just as well by the bronze process.

Presented at the May, 1925, meeting of the New York Section of the American Welding Society.

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A Comparison of Methods for Testing Hardness

Absence of definite concept of hardness—Scratch hardness, wear, rebound and impact, crushing and bending, penetration — Comparative hardness data

By H. E. Degler
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TO FIND out exactly what hardness is and to state its measure in any of the fundamental units is an aim of science that no one has thus far attained. The absence of any theory of what constitutes hardness is significant of the complexity of the characteristic of materials which is denoted by the term. The hardness of ivory is different from the hardness of lead, and this again is different from that of rubber, yet any definition of hardness which is to be as scientifically correct as temperature, density, or ultimate strength, for example, must be applicable equally to all substances.

The concept of hardness originated from a sense of resistance offered by materials to the action of an approximately static force. As to the character of hardness, there is a diversity of opinion; the engineer believes it fundamentally important, while the physicist does not recognize it as one of the more essential properties of matter. There seem to be two general classes of hardness: superficial hardness, otherwise referred to as resistance to abrasion; and penetration hardness, oherwise referred to as deformation hardness. Both of these are spoken of as resistance to penetration or deformation of shape. A definition of hardness to cover both kinds might be stated as follows: Hardness is the cohesive resistance of the molecular aggregate structure of a material to any deformation of form. For the engineer this definition is probably worthless, because he deals not with limited structures uniformly loaded, nor with large aggregates in which there are highly localized strains, but rather with the combination of the two. Mechanical limitations, such as direction and manner of application of the stress, together with its magnitude and duration, are factors of an indefinite character. This indefiniteness has resulted in many definitions for hardness, in each case depending upon the personal aims of some individual. Among these may be mentioned hardness, as determined by scratch, wear, rebound, impact, crushing, bending, penetration, and deformation. Each of them will be considered in the order named.

Scratch Hardness

Scratch hardness is probably the oldest, and may be defined as the property or quality whereby one material abrades another, the scratched material being the less hard. The method of testing materials with a file has been used for years by machinists and heat-treaters. The mineralogist uses the Moh scale, diamond 10, sapphire 9, topaz 8, quartz 7, feldspar 6, apatite 5, fluorspar 4, calc spar 3, gypsum 2, talc 1, the high numbers being harder than the lower numbers. Referred to this basis, the engineer uses a file test giving a hardness of 7, 6, or 5 to such materials as are scratched by a file of a certain type. Copper has a hardness of 3 and wrought iron 4½ by this method. But can a scratch give a true value of hardness? It is questionable, for it depends:

1. Upon the operator's personal equation.
2. Pressure at which the tool is applied.
3. Type and character of the tool.
4. Angle at which the tool is ground and the angle at which it is applied to the work.
5. Speed of application.
6. The uniformity and character of material.

Furthermore, "diamond cuts diamond," "glass cuts glass," depending upon the molecular arrangement of the material and the chemical analysis of the specimens. In itself a scratch is not a proper indication of hardness. It may be considered a measure of a surface property only, the skin hardness of a material.

Wear

Hardness is also defined as the resistance to wear as determined by the amount of material removed in thousandths of millimeters; the degree of hardness is thus fixed if worn off under a fixed load in proportionate times. Can the resistance to wear of a piece of steel shafting be predetermined by a scratch test? Hardly, because after the first few thousand revolutions of the shaft its surface is no longer in the original state; it is polished, and though probably not measurable by any of our present methods, is harder than before, because of finer grain structure. For some materials, ductility is probably a better measure of the resistance to wear than hardness.

Rebound and Impact

In the ball bearing industry, the height to which the specimens rebound, when dropped upon a fixed plate properly hardened, has been taken as a measure of hardness. This is not truly a hardness test, but rather an indication of the resilience of the material. It measures the energy stored in both the material being tested and that upon which rebound takes place. Almost any impact hardness test is either of the resilient or semi-resilient type. In a hardness test, in the usual sense of the term, a permanent deformation is produced.

Impact is usually accompanied by a rebound which depends upon the rate at which the compression wave travels into the specimen and the impacting medium. Thus, rebound is a function of the duration of impact. The scleroscope measures the height of rebound of a standard weight when allowed to fall a given height upon the article to be tested. Comparison readings can be made with the scleroscope only when testing like materials in the same manner. The fact that rubber, glass and hard steel may give the same reading again emphasizes the fact that rebound hardness should be comparative readings of like materials tested under like conditions. Some of the conditions that effect the readings of the scleroscope are: size and thickness of piece to be tested; flatness; and condition of surface, such as rough, ground or polished.

Crushing and Bending

Still another test makes use of the crushing of specimens as a measure of hardness. The fracture is examined microscopically and the hardness judged from the degree of packing and smoothness of the surface.

For wires and small sectional specimens, the resistance offered to bending is often taken as a measure of hardness. The fracture is examined microscopically and the hardness judged from the degree of packing and smoothness of the fractured surface.

For wires and small sectional specimens, the resistance offered to bending is often taken as a measure of hardness. It is customary to determine the number of reversals, to which a given specimen may be subjected without rupture, by bending through definite angles. The lower the number, the harder the material. In any crushing or bending test, the resulting decision must be dependent upon the prehardening by the working of the materials while testing. But such tests have a significance from which conclusions as to the usefulness of a material can be drawn.

In connection with crushing and bending tests are correlated other properties of materials, especially brittleness, ductility, plasticity, and tenacity.

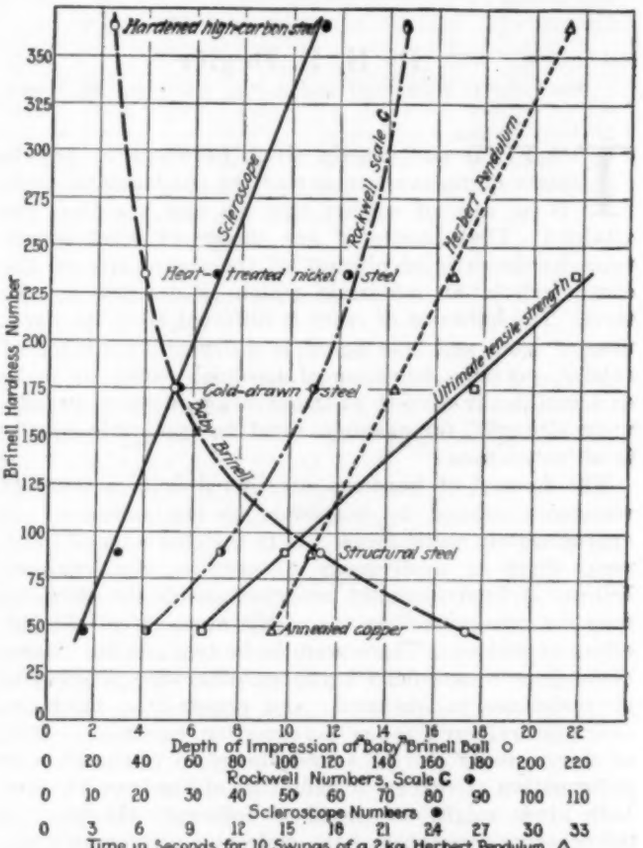
Penetration

Resistance offered by materials to penetration is more generally said to be the definition of hardness. In determining hardness by any penetration test, it is necessary that the elastic limit of the material be exceeded. Once the elastic limit has been reached, further deformation of material takes place and gives in reality the deformation hardness; this type of hardness is usually measured by any of the indentation devices such as the Brinell, Rockwell and the Herbert pendulum. In practice these hardnesses are all dependent upon the deformed state; that is, the material ahead of a penetration device is packed more and more once the elastic limit is exceeded and becomes harder to the point of rupture.

It is found impossible to correlate penetration hardness with the physical properties of some materials such as manganese steel, certain bronzes and duralumin, when rolled, hammered, worked or hardened. Can a penetration test lead to a true hardness? It would appear likely, if deformation were carried out to the yield point so rapidly that the resistant force at this point would be a true measure of cohesive resistance. But one cannot uniformly load a portion of the material at a point just below rupture, neither can the true deformation at this point be measured.

In general, no restrictions are placed on the time of application of the stresses for hardness testing. A simple consideration of the time required to accelerate masses to a given velocity calls to mind the fact that it is very important even though such masses be of molecular magnitude. It requires time for displacement of molecules to occur.

Some time ago an investigation was made of complaints that the readings on the Rockwell "C" scale, using a sharp, cone-shaped, diamond point for the penetration test, were not consistent, even on the same surface of one specimen. Tests were made on pieces of brass


Hardened high-carbon steel
Scleroscope
Rockwell scale C
Herbert Pendulum
Heat-treated nickel steel
Cold-drawn steel
Ultimate tensile strength
Baby Brinell
Structural steel
Annealed copper
Brinell Hardness Number
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350
Depth of Impression of Baby Brinell Ball
Rockwell Numbers, Scale C
Scleroscope Numbers
Time in Seconds for 10 Swings of a 2 Kg. Herbert Pendulum
Ultimate Tensile Strength in Lb. per Sq. In.
20,000 40,000 60000 80,000 100,000

Comparative hardness curves; also Brinell hardness and ultimate tensile strength

having very coarse crystallization; the crystals could be seen by the naked eye. The tests were made by taking from one to four readings on single crystals. It was found that some crystals showed a Rockwell hardness of C18 to C20, other crystals gave readings as high as C40; in some cases such variance was noted for crystals side by side. This was further verified by testing a transverse section of cold-rolled steel shafting. The Rockwell readings showed a gradual increase from the center toward the outside, whereas the Brinell tests showed the same hardness across the section. This partially explains the lack of consistency between Rockwell readings as compared with the Brinell for some materials, the difference being due to the fact that the Rockwell "C" scale indicates the hardness within a comparatively small area tested, while the Brinell, with its comparatively large ball, gives an average—what might be called an integrated—reading, over a fairly large area.

The accompanying curves* show the correlation between the Brinell hardness number and three other common hardness tests, also the relation between the ultimate tensile strength and the Brinell number. These curves may not be conclusive because of the few specimens tested, but they prove that the hardness number is a general index of the ultimate strength and that there is some relation between the various hardness tests as used today.

The table shows the chemical composition, heat-treatment, hardness numbers and ultimate tensile strengths of the metals tested. The figures given are the average of five tests each on two specimens for each kind of metal, and were used to plot the curves.

Since strength and hardness are, in general, dependent properties, hardness tests form a convenient method of estimating the tensile strength of machined or other parts from which it would be impossible or not feasible to cut a test specimen. After experience has demonstrated the kind of material to be used for a given service and the treatment to be given the material, a hardness test may be used as a "control" test to insure the correct material and proper heat-treatment, and thus form a convenient way of determining whether or not the desired properties are being obtained.

With the present and increasing competition among manufacturers, it is essential that their products be

Summary of Results

Metal	Chemical Composition (Values in Per Cent)	Heat-Treatment	Brinell Hardness Number	"Baby" Brinell Impression by Ball of $\frac{1}{16}$-In. Diameter	Rockwell Hardness Number "C" Scale	Scleroscope Hardness Number	2-Kg. Herbert Pendulum Time in Seconds for 10 Swings	Ultimate Tensile Strength Lb. per Sq.In.
Hardened high-carbon steel	C, 1.02 Mn, 0.24 Si, 0.145 S, 0.029 P, 0.012	1,500° F. Quench in oil	365.0	2.4	C146.0	56.0	32.0	108,000
Heat-treated 3½ per cent nickel steel	C, 0.20 Mn, 0.65 Ni, 3.50 S, 0.04 P, 0.03	1,550° F. Quench in oil. Reheat to 1,000° F. Cool in furnace	235.0	3.9	C123.0	34.5	25.0	108,500
Cold-drawn steel (screw stock)	C, 0.20 Mn, 0.67 Si, 0.03 S, 0.09 P, 0.03	As received Cold-drawn	175.0	5.2	C109.3	27.0	21.5	88,000
Structural steel rod	C, 0.18 Mn, 0.37 Si, 0.06 S, 0.04 P, 0.02	As received Hot rolled	88.7	11.3	C72.0	15.0	16.5	49,400
Soft copper	Copper 99.985	Annealed	47.0	17.4	C42.0*	8.0	14.0	32,200

The curves and table show that:

1. The "baby" (small ball) Brinell hardness tester gives the best results when comparing the softer metals.
2. The Rockwell hardness tester, with a diamond cone point and the C-scale, can be used for comparing soft materials with harder materials providing that the total number of divisions over which the pointer moves from its initial to final position is observed. This reading indicates the depth of impression of the diamond point. If the readings are subtracted from 100, the C-scale Rockwell numbers are obtained, and on the ordinary Rockwell dial this subtraction is taken care of automatically, except in cases where the pointer makes more than one revolution. In these tests the pointer moved more than one revolution and the Rockwell C-numbers were obtained by subtracting from 200.
3. The relation between the scleroscope readings and the Brinwell numbers is a straight line for metals.
4. The relation between the time required for ten swings of the Herbert pendulum and the Brinell numbers is a straight line for metals.
5. There is a fairly definite linear relation between the ultimate tensile strength and the Brinell numbers. However, the above results indicate that for hard materials (above 300 Brinell) this relation probably does not hold as well as for soft materials.

*Data obtained in the Laboratory of Applied Mechanics, University of Illinois, under the direction of Prof. H. F. Moore.

turned out uniformly and up to a given standard for hardness or temper. The product can be checked with a standard only by means of a testing machine that will give reliable results. The service which the machine will render depends upon the judgment and care of the operator in its operation and maintenance. File tests, fracture tests or rebound tests are fairly satisfactory in certain cases. But if a heat-treater were told to temper an article to "file readily," it would not have a fixed value or even one varying within close limits; also the property of the article to "file readily" would be greatly influenced by the type of file used and the operator using it.

There are enough and to spare of so-called "hardness tests" and nothing can probably be gained by devising any more. If a certain Brinell number, scleroscope number, Rockwell number, or scratch, which is found to be associated with the quality of the material, is satisfactory for a certain purpose, then that particular number or width can be used as an acceptance test for the material. In spite of all efforts which have been made to justify the several tests by scientific considerations they still remain empirical determinations of an unknown quantity. If hardness is wanted in a material for the resistance of abrasion, the amount of abrasion

produced under given conditions is the only true measure of the kind of hardness required. If penetration is to be resisted, as in the case of armor plate, some kind of penetration or indentation test is suggested. If, on the other hand, hardness is taken as an indication of tensile strength or of chemical composition, it is surely better, whenever possible, to determine these properties directly.

For a number of years various experimenters have tried to find a correlation between physical hardness and magnetic hardness, as measured by the action of the material in a strong electrical field, especially for iron and steel. This is still a live issue and may eventually prove the solution of the hardness question.

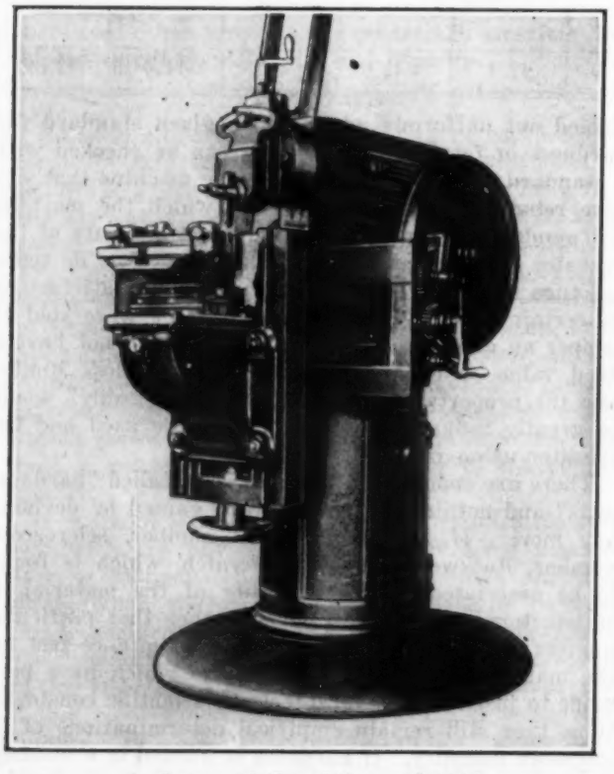
The ease with which certain so-called tests of hardness can be applied to finished material without injuring it, and the numerical results obtained, tend, by reason of their attractiveness, to disguise the fact that hardness is an unknown quantity and is one which may or may not be correlated with the properties desired. The subject of hardness will probably never be put on a scientific basis until the physicist has come to some agreement as to what property of the molecules or combination of molecules gives this quality to a material.

An Old Shaper

By M. B. Roderick

The illustration is of an old shaper in the toolroom in the Susquehanna shops of the Erie Railroad.

The machine was bought from the New York Steam Engine Co., in 1863 and is still in service. It has been operated through the administrations of eleven master mechanics and six toolroom foremen, and the only repairs it has had were made in 1915, after more than fifty years' continuous service. The original chuck was in use until 1917, at which time it was discarded.



A shaper of the vintage of 1863

Seen and Heard

By John H. Godfrey

Tight boots and Navy cold chisels

WAY back in the days of Methuselah we used to have a joke about the man who ordered a pair of boots, and found them much too small to get on.

"I can't get these boots on," said Mr. Customer to the cobbler.

"Oh, you can get them on all right after you wear 'em a week" was the cheery answer.

I hadn't thought of this joke in years until I picked up a copy of the Navy specifications for cold chisels the other day, and here it was, staring me in the face, in another form of course. Whoever wrote the specifications couldn't very well work in about the tight boots, but he got the idea all right. Here is what he says about buying cold chisels, those all important articles for national defense:

> "Bids for chisel blanks will be considered from only those manufacturers whose chisel blanks have been found, after service tests, to be satisfactory for the purpose, and the department reserves the right to reject any bids on chisel blanks which are unknown or have not been subjected to the required tests."

If this is actually carried out, no maker who is not already supplying satisfactory chisel blanks can get an order, no matter how good his chisels may be. Neither price nor ability to make prompt delivery will avail him anything.

It is, of course, very easy to get excited over governmental ways of doing business, and much easier to criticise than to find a better way of doing it. Buying material without bids is always open to suspicions of favoritism, and frequently the system of bidding seems to compel the acceptance of an inferior article. To be sure there is always the chance to reject a bid, but it is not always easy to explain the rejection of a bid, especially if it is lower than the one accepted.

Legitimate Favoritism

Every large commercial buyer has a preferred list of those who supply him with material or machinery, the preference in most cases being due to previous experience with the product and the method of doing business. That this has many advantages can hardly be questioned. And while it cannot be openly acknowledged perhaps, the system prevails in some governmental departments, usually with good results. In Great Britain the Air Service buys openly on this basis and finds it advantageous to do so.

We have not yet adopted this method, at least not openly. But some of the awards for contracts are such as to make one wonder what system is in use. When, for example, bids are asked for 100 pieces and the lowest bidder, who has an excellent reputation, is awarded only 20, while another and newer bidder, approximately 50 per cent higher in price, also gets the same number, he wonders, just why bids were asked for anyhow. If the purchasing official had made up his mind to try 20 from each bidder, why not order direct without bothering about bids?

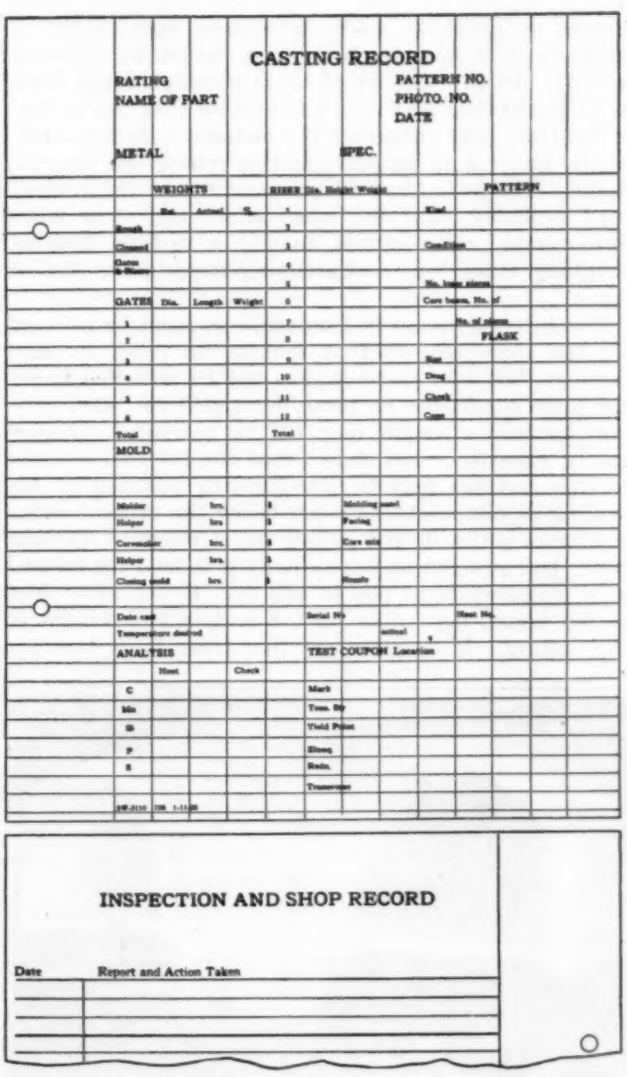
The only answer seems to be that government purchasing officials are not experienced business men, and that in some departments at least, about the time they learn, they are shifted to another department.

Annealing Large Castings to Prevent Distortion

By J. A. Capp
Engineer, Testing Laboratory, General Electric Co., Schenectady

Advantages of double annealing—Temperatures maintained and time intervals—Difference in treatment of steel and iron castings—Performance records to guide future foundry practice

THE steel and iron castings used in the turbines built at the Schenectady Works of the General Electric Company are, in most cases, of large volume space and have relatively thin walls. In addition they are likely to have many webs and partitions, also of thin section. Because of the different rates of cooling of the various sections, severe strains are often set up in the metal. The castings are stable under a given set of conditions—the set existing as the castings come from the sand and cool. Any disturbance of the conditions is sure to result in some warping.


CASTING RECORD

RATING
NAME OF PART
PATTERN NO.
PHOTO. NO.
DATE
METAL
SPEC.

WEIGHTS — Est. — Actual — Cl.
Smith
Closed
Gates & Risers
GATES — Dia. — Length — Weight
1
2
3
4
5
6
Total
MOLD
Molder — hrs.
Helper — hrs.
Coremaker — hrs.
Helper — hrs.
Closing mold — hrs.
Date cast
Temperature desired
ANALYSIS — Heat — Check
C
Mn
Si
P
S

RISER Dia. Height Weight
1
2
3
4
5
6
7
8
9
10
11
12
Total

PATTERN
Kind
Condition
No. loose pieces
Core boxes, No. of
No. of plates
FLASK
Size
Drag
Cheek
Cope
Molding sand
Facing
Core mix
Sharp
Serial No.
Heat No.
actual
TEST COUPON Location
Mark
Tens. Str.
Yield Point
Elong.
Redn.
Transverse

INSPECTION AND SHOP RECORD

Date — Report and Action Taken

Fig. 1—The form used for recording casting details

Turbine castings are subject to two entirely different kinds of disturbances, those resulting from machining and those caused by temperature variations incident to the operation of the turbine. The removal of metal by machining sets up new conditions of equilibrium of internal stresses, to which the casting adjusts itself by warping. It might be possible to machine a casting to the required shape and dimensions, which would be stable at the temperature at which the machining operations were done; but in operation the casting is subject to changes of temperature through a considerable range and the conditions of equilibrium of internal stress may vary markedly with temperature change. The consequence would be more or less warping of the casting, in addition to its normal expansion and contraction with changing temperature. This might result in alterations of clearances between the rapidly moving parts and might even throw bearings out of alignment and tend to set up vibration. All of this points to the necessity of completely releasing or removing internal stress in such a casting as nearly as possible.

Annealing Presents Double Advantage

As the steel casting must be tough, ductile and strong, careful annealing is a reasonable metallurgical precaution. But annealing for grain refinement has also the advantage of relieving internal stress. It must be thorough and come as near as is commercially possible to breaking up dendritic structure. Although one can advance no unanswerable metallurgical argument to prove that two shorter anneals are better than one longer one of the same total duration, it is a fact that the divided period gives far better results with turbine parts from the standpoint of producing stable castings.

Our practice is to inspect the castings for visible defects and then give them a sound commercial foundry anneal at a temperature of about 850 deg. C. The temperature is maintained for from 4 to 8 hours, depending on the section and weight of the castings, which are then permitted to cool with the furnace. Even after this anneal, castings may warp as much as 0.005 to 0.015 inches after machining operations, obviously too much for stability.

The next procedure is to perform all rough machining operations and do any patching or welding of imperfec-

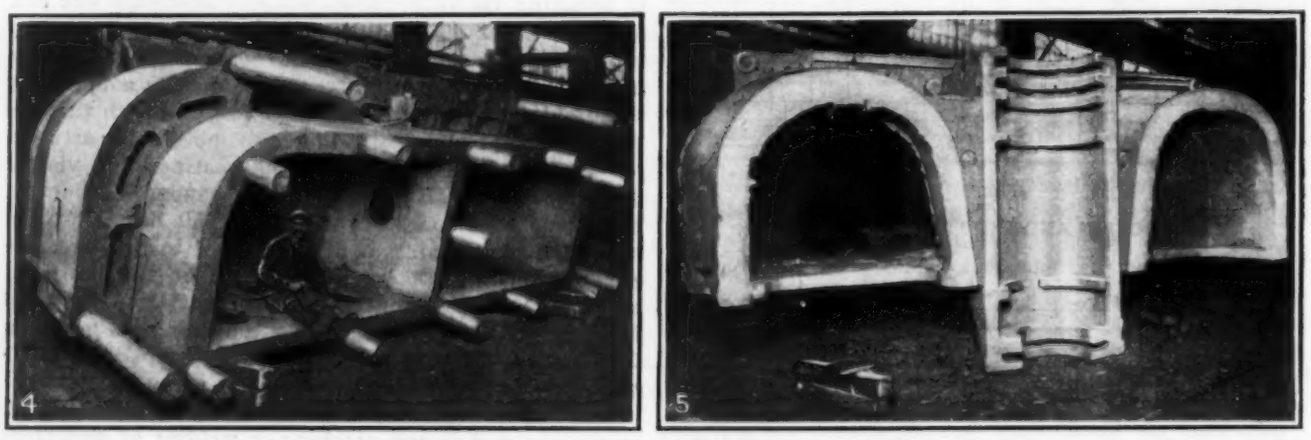
Figs. 2 and 3—Views of the mold in different stages

tions that is deemed safe after a consultation as to the wisdom of making such repairs. The castings are then returned to the annealing furnace and given a second and even more careful anneal under about the same conditions as before.

As has been said, the machining has upset the conditions of equilibrium of internal stress set up on the cooling of the casting in the mold, and it has been found that it is easier and more certain to produce the desired stability and freedom from internal stress by permitting this first warping and then to anneal the casting a second time.

Iron castings are necessarily treated somewhat differently from steel. Everyone is familiar with the old practice of ageing castings out of doors in the casting yard. The practice is sound enough but it ties up a great deal of money in raw material and delays production. An internally strained iron casting not only tends to warp but it may not develop its full strength. Outerbridge discovered that tumbling apparently raised the physical properties of small castings. This has been explained as being due to the relief of internal strains. Howe's definition of cast iron as a metallic matrix with its continuity broken up more or less completely by masses of graphite, as by a foreign body, helps in understanding how tumbling may assist in relieving internal stress. The graphite is usually in the form of little flakelets and it is conceivable that the jolting or tumbling may encourage the metallic matrix to shift on the lubricating graphite and so relieve the internal stress. The variations of temperature in the casting yard probably have the same effect but at a much slower rate. One cannot tumble a turbine housing weighing many tons and occuping many cubic feet of space.

The internal stress in iron castings must be relieved for the same reasons that require its relief in steel castings, but iron castings may not be annealed under the same conditions as those demanded for steel castings because strength may not be sacrificed. Fortunately, experience has shown that the internal stresses in iron castings may be satisfactorily relieved by annealing at temperatures much below the critical range and hence which do not impair the strength of the cast iron. Our practice at Schenectady is to hold the casting at a temperature of 500 to 550 deg. C. for some four to ten hours, depending on the section and weight of the casting. It is important that these large castings



Figs. 4 and 5—Two views of the rough casting

be properly supported so that they do not sag when hot and set up a new condition of internal strains.

An electric car-bottom furnace 16 feet wide by 28 feet long by 9 feet high is used for annealing the iron castings. The difficulty of maintaining uniform temperature distribution in a fuel-fired furnace of this size operating at as low a temperature as 500 deg. C. was one of the deciding factors in the adoption of the electric furnace.

Oil-fired, car-bottom furnaces of sizes nearly as large are used for annealing the steel castings. Because of their large size and intricate shape, it is necessary to cool these castings in the furnace almost to room temperature if complete stability is to be obtained. Cooling through this long temperature range in a tightly sealed, well insulated electric furnace greatly prolongs the annealing cycle. The castings vary so greatly that sometimes a furnace may be full with only 25 tons in the charge whereas, with other castings, it may be half empty with 75 tons in the charge. The oil furnace has proved somewhat more economical for heating these heterogeneous charges from room temperature to the annealing heat, and the required uniformity of distribution of temperature may be obtained and held by educated judgment on the part of the operator, based on indications of the pyrometers placed in significant locations with respect to the charge. If it were possible to operate on a cycle which permitted the withdrawal of the charge to cool in a separate cooling chamber or to normalize in air, the electric furnace would have been preferred because of the greater certainty of uniform temperature distribution and easier control and, under such conditions, even large electric furnaces are proving economical. Just as in the case of the iron castings, judgment must be used in the stacking of the castings, to prevent warping or stressing.

Where Investigation for Control Must Start

To secure the kind of castings we must have, it is not sufficient to start with rigid control only after the castings are made. Instead, we must go back to the actual production of the castings themselves. Furthermore, the castings are of such huge proportions that the loss of even one casting entails a very considerable expense. Successful foundry practice is therefore necessary.

The steel castings are mostly of the class commonly specified as "medium" steel, whereas the iron castings are usually of the grade which we designate as "turbine iron." Turbine iron is the dense, strong metal made by charging 25 per cent to 40 per cent of steel in the cupola with the pig iron and scrap. It is particularly necessary to anneal such castings for stress removal.

As has been stated, the castings occupy a large space but have comparatively thin sections in the walls and partitions. It is, therefore, a matter of nice judgment on the part of the foundrymen to decide the best method of molding such castings and to provide them with the necessary feed. Not only must the mold be kept filled but there must be freedom from cracks or tears due to contraction. But it is even more important that there be freedom from draws and voids due to improper or insufficient feeding. Records are therefore kept of each casting showing not only what went into it but also what was found when it was uncovered from the sand. If the casting is a success the fact is recorded. If it is a failure for any reason, a sort of post mortem is held and the facts developed are recorded and a decision reached as to the steps to be taken to prevent repetition of failure. The written record is on the form shown in Fig. 1. At the same time we make use of the photographic camera and take pictures of the casting from various angles as Figs. 2 to 5 will show.

The records and photographs are filed away under the pattern number and are always consulted before any work is done when other castings from the same pattern are ordered. Sometimes it is a matter of months before a pattern may go back into production, and, without the record, the mistakes first made might easily be repeated. None of these records is ever destroyed. They are charged to the foundry overhead and have been the means of saving much money.

The Inspection Department—Discussion

By H. Ellsworth

The continued discussion regarding this most important department, in the columns of the *American Machinist* will, I trust, cause us to appreciate its need more fully. As W. B. Wallace points out on page 14, Vol. 63, the personality of the inspector is the big factor.

Where there is but a single individual in the department, the work surely requires one with not only proved ability as a workman, but with great good judgment, patience and tact, and the same should be said if he has several or many assistants. To hold such an inspector, means that he shall be given the fullest authority, whether the production department likes it or not, for if not given full authority, he would be likely to give up the job.

A carefully and conscientiously-inspected product is sure to be a popular one. He who thinks he saves by neglecting to form an inspection department, soon finds that complaints, replacements, ill will, and loss of business are sure to result. When the product in the plant is being inspected by the buyer's inspector or inspectors from an agency, great care must be exercised that perfect good will and honest dealings are maintained, so that misunderstandings may not occur and bad feelings be engendered. Tact must be used by all hands.

The last war taught many of us the great value of thoroughly critical inspection, and also to what foolish lengths inspectors could go. The lessons then learned should never be forgotten.

I am speaking for machine shops, having in mind principally the machine-tool shops where, if small, they may think the superintendent will answer as inspector, but this does not always work to advantage, since he may be more interested in an early delivery, even on a risk that the machine will function as it should when delivered and set up in the purchaser's shop.

I have in mind an instance that occurred in a near-by machine-tool shop, known the world over for good workmanship, where the inspector held up the delivery of a much-wanted machine on account of a poorly fitting toolpost screw, and the management, though urged, would not deliver the machine until the fault was corrected to the satisfaction of the inspector. Quiet and thorough, he was a terror to the shopmen, but when he put his O.K. on a machine, all fear fled from the minds of men as well as management.

So our slogan should be "Back up the inspector to the limit."

Depreciation Claims for Tax Exemption

By L. L. Thwing

AN ARTICLE on a decision of the U. S. Board of Tax Appeals is headed, "Depreciation exemption is not always approved by the Tax Commission." Reading between the lines of this decision and recognizing the space limitations of headlines, I believe that the headline should read, "Do not claim an unreasonable depreciation or you may not get even what you are entitled to." The facts seem to be that the taxpayer claimed a 20 per cent rate on buildings and a 10 per cent rate on machinery, this rating being based on the book value at the end of the year for which the deduction was claimed. Now the determination of rates of depreciation is not an exact science and it is impossible either to prove or to disprove any rate that the taxpayer may choose to claim. But it should not be forgotten that the Income Tax Unit does not have to disprove it. The burden of proof, and practically of evidence, is all on the taxpayer. He should recognize that he cannot prove anything about the future and should therefore be reasonable in his claims. He further should take into consideration the generally accepted practice as to rates of depreciation that are commonly accepted among accountants. These rates are liberal in 90 per cent of all cases.

Depreciation Too High

The taxpayer under discussion claimed as a yearly rate of depreciation, 20 per cent on the buildings. On the face of it this rating is unusually high and so unless it is supported by something more than someone's opinion—expert or otherwise—it is very likely to be considered an exorbitant claim. Subsequent facts have proven it to be a claim not warranted by fact. The building was apparently two years old when purchased. The purchaser would have the right to base the rate of depreciation on the remaining life of the building. He estimated it to be five years. If his estimate was correct the building would be worthless now except for its value as scrap.

Since the building is in use yet, it is evident that it still had more than five years of useful life and that the disallowance of a 20 per cent depreciation rate was reasonable. Whether or not a 10 per cent rate is correct is another matter. This high rate was probably allowed because these buildings, or a part of them, are of all-steel construction which deteriorates more rapidly than other types.

A Conservative Rate

In regard to the machinery, it appears that someone may have taken the reprehensible but very human attitude that since the taxpayer was unreasonable in his demands on the buildings, he probably was unreasonable on the machinery as well. Machine tools are commonly allowed a rate of 10 per cent without question, unless they are of a heavy, slow-moving type, and even then such a deduction would probably be allowed since a description of the machine is not usually furnished to the auditor. The machines in question were second hand when purchased and, considering the conditions under which machinery is used in the oil country, it would seem that 10 per cent was a very conservative rate of depreciation for the circumstances.

Any taxpayer who wishes to be allowed a definite amount of depreciation should be reasonable in his demands. If his conditions warrant a rate above normal, his demands should be conservative. His problem is to prove that he has an abnormal condition. All taxpayers have conditions that are peculiar to themselves, but this should not be confused with abnormality. If he has an abnormal condition, the hard part of his problem is to submit evidence indicating the proper weight to be given to this abnormality. It is always easy to enumerate the conditions that produce abnormality but to assign a definite loss to each of them is in fact impossible. The writer recently examined a brief claiming super-depreciation on cotton-mill machinery located in a southern mill. The brief was prepared by a well known and reputable engineer. It cited that on account of the location of the mill and the conditions peculiar to the year 1918, the rate of depreciation for that year should be built up as follows:

Normal rate	10 per cent
50 per cent over time	5 per cent
Poor help	2 per cent
Difficulty in securing repairs	1 per cent
Inadequate facilities for repairs	1 per cent
Rusting due to climate	1 per cent
Total	20 per cent

No fault can be found with the causes offered, in fact they might be added to. It is the specific allowance claimed, that is open to question. In the first line the taxpayer has prejudiced his case by claiming twice the normal rate. Anyone who has had experience with cotton mill machinery knows that even 5 per cent has been more than adequate during the past generation. There is serious doubt if wear and tear increases in direct proportion to use. Repairs absorb a large proportion of depreciation—particularly in this case. Having now become of a critical frame of mind, the examiner may continue by attacking the other items, on which he has the advantage of having the last word. If the taxpayer had cut his first item down to 5 per cent and his second to 2 per cent, he would stand a good chance of having the balance allowed, thus giving him a total of 12 per cent. As it is, he will be lucky if 10 per cent is allowed.

Only Evidence Counts

The lesson to be learned from the article previously mentioned is to be not too grasping or to try to get more than the facts warrant. Remember that your case is going to be judged by an ordinary human being with ordinary faults and limitations. Even Supreme Court judges are presumed to breathe the same air as the common people. Remember that you are trying to prove something that can't be proved and the best that you can do is to offer evidence. If your case is fundamentally sound, your superintendent's testimony should be pertinent, and I suggest that you take him along with you when you go to Washington to argue your case. Let him do most of the talking, if you can get him to do it. He knows more about the actual wear and tear on his own machinery than anyone else doesn't he? His opinion will be taken as more nearly unbiased and this point is important because the element of bias is one that legal eyes are constantly on the alert to avoid.

Automotive Production

Fig. 1—Battery of electrical-type heat-treating furnaces in the production line

Where Should Heat-Treating Be Done?

By John Younger
Associate Editor, *American Machinist*

A study of the methods in use by the Ajax Motors Co., particularly as related to gears — Advantageous use of the electric furnace placed in the production line

IT USED to be felt, and it still is in many quarters, that heat-treating in automobile shops should be carried out in a department all to itself, where the metallurgist can have all his operations under easy supervision.

Visitors are shown with pride long batteries of furnaces, each with its pyrometric couple in touch with a central pyrometer station. There is no question but that this imposing array leaves a favorable impression in the mind of the observer, particularly if the same standards of factory cleanliness prevail as in other parts of the plant.

More recently, however, some pioneering minds began to question the advisability of piling material into tote boxes, carrying it to the heat-treating department, often some distance away, leaving it to take its time at the furnaces, then piling it again into the boxes and carrying it back to the grinding machines. These pioneers even found that the second handling often caused damaged parts, particularly damaged gear teeth, through carelessness, and that to avoid damage, greater precautions than the average man understood were necessary. The usual steel part, immediately after heat-treatment, does not look like a particularly sacred object and the usual trucker has not the same respect for it that he has for a bright, shiny piece.

Gears are naturally the most accurate product turned out for the automobile, and their heat-treatment is a serious matter if good after-results are to be obtained. They have, however, compensating advantages and those are that differing gears vary comparatively little in diameter and are above all things round. These factors cause gears to lend themselves admirably to heat-treatment in a compact, round furnace, generally one of the newer electric types. If this type of furnace is selected there is little fire risk, and the furnace can be placed virtually anywhere.

Such considerations prompted W. G. Careins, of the

AUTOMOTIVE PRODUCTION

Fig. 2—Hobbing gear teeth and shaft splines

Ajax Motors Co. of Racine to place his heating furnaces for gears with their pyrometer and tank equipment right in the production line, as shown in Fig. 1, between the gear shapers and the grinders.

The practice of heat-treating in the line makes for an ideal layout, the gear having minimum handling and being supervised through its machine shop life by a man who thoroughly understands gears. This final consideration is no unimportant one, as gears are temperamental objects in many senses of the word. Another consideration, undoubtedly of weight where quick turnover is in effect, is that the number of gears in process can be cut down considerably as they are toted almost one by one to the furnace, instead of waiting for an accumulation for the truck.

It will be noticed from the illustration how compact the unit is, and observation showed how clean and cool it was kept, totally avoiding the troubles of a central unit in this respect. The furnace is of the Leeds-Northrup electric types, controlled by Leeds-Northrup pyrometers. Gears are heated to a temperature of 1,450 deg. and on being taken out are immersed in a cyanide bath for eight seconds before being quenched in oil. Earl G. Gunn, chief engineer of the Ajax Co., states

Fig. 3—Battery of Fellows shapers

AUTOMOTIVE PRODUCTION

that this practice gives the gears a hard skin with ability to resist clashing and ordinary wear. Finally the gears are immersed in a nitrite salt bath until they reach a temperature of 450 deg. F., after which they are thoroughly cleaned in boiling water. They are then immediately taken to the grinders. The scleroscope hardness—and each gear is scoped—reads 70 after this treatment, the gears being of the medium carbon-alloy steel tempering type 0.40 to 0.50 per cent carbon and 3½ per cent nickel.

In discussing the subject of heat-treating gears, and the place of the heat-treatment in the operations, it is worth while considering the whole sequence of operations.

Gears other than simple blanks are first upset in an Ajax machine, this process being done to insure an even flow of fiber structure throughout the teeth. All gears are then drilled and reamed on Warner & Swasey machines or Jones & Lamson double-spindle machines and then rough turned on Fay automatic lathes. They are then drilled, either on Natco or Barnes machines, and broached on an Oil Gear Co. machine. The teeth on all gears are rough cut on Gould & Eberhardt hobbers. At the same time the splines on the corresponding shafts are hobbed on Gould & Eberhardt and Lees-Bradner machines, of which a battery of the former is shown in Fig. 2. The teeth of the gears are then finish cut on a battery of ten Fellows high-speed shapers as shown in Fig. 3. Gears of 28 teeth are finished in 7 min., and other sizes are cut in proportionate times. The teeth are then rounded on a W. C. Lipe machine and are finally washed in a Blakeslee metal washer, being supported in baskets hauled through by a conveyor chain.

Then follows the heat-treatment as previously described, after which the gears are finished internally on Heald grinding machines and externally on Landis grinding machines, thus completing the operations.

To Encourage Simplified Practice

Suggestions are coming to the Department of Commerce that it should do more than initiate simplified practice programs. In the elimination of excess variety, for instance, some industries are finding that a follow-up campaign is desirable. They think agents of the Department of Commerce can do the follow-up work better than can anyone else. There is no thought of coercion, the sole purpose is to do educational work. In some instances, it is necessary to convince the manufacturer that adherence to standardization is in his interest.

There has been some misunderstanding as to the extent to which simplification is to be carried. It is to apply to stock size only. There never has been any intention of discouraging anyone from producing an odd size or special variety on order. There is no thought of inducing a manufacturer to an agreement which would put him in a position where he could not fill any unusual order if he so desired.

The disposition of the department apparently is to leave the educational work to the industry concerned, but seemingly some of the manufacturers most interested in seeing simplification succeed feel that a federal bureau could perform this service much better.

The Whaley Constant-Pressure Oil Engine

THE Sun Shipbuilding and Dry Dock Co., Chester, Pa., has completed the construction of the new Whaley oil engine invented by William B. Smith Whaley and described as a single-acting, four-cylinder, two-cycle, 750-hp. engine.

The Whaley engine has the usual form of port scavenging supplemented by high-pressure scavaging and supercharging through the top of the cylinders. The last two operations are carried out with air at a pressure of about 45 lb. per sq.in. from air pumps contained in the lower part of the power cylinders and a supplemental pump in the upper part of the frame, in which operates a piston placed on top of the crosshead.

Two cylinders are cast in block with a valve chest between them. The air from the pumps is used either in direct line or is transferred through the ports in the valve chest to the opposite cylinder. The air is controlled by piston valves, one working inside the other and both actuated by links similar to those on reversing steam engines. By linking-up, the opening of the piston valves is made to synchronize to the period of fuel injection so that for all practical purposes, combustion takes place during the entire time that the valve is open.

The Clearance Reservoir

The cylinder clearance, at the time of the fuel injection, is opened by a piston valve to communicate with a static receiver having many times the capacity of the cylinder clearance. The main purpose of the clearance reservoir is to maintain the maximum working pressure desired which is 350 lb. per sq.in. in this model. Since this is the normal compression-pressure of each working cylinder, it is also the normal pressure for the receiver or reservoir. The receiver serves as an absorber in case of any rise in pressure in the cylinder and the compression-space port is made to serve successively for the introduction of the super-scavenging and supercharging and to establish communication with the reservoir or receiver during the combustion period.

The fuel pump is placed on top of the valve chest and driven directly from the valve stem. The pumps deliver the charge of oil for each stroke directly into each individual fuel valve at pressures between 4,000 and 8,000 lb. per sq.in. The action of the pumps synchronizes with the action of the valves to maintain the relation between the fuel injection and the duration of the valve opening to cut-off, and to prevent any rise in pressure in the cylinders beyond that due to compression.

In the whole engine, the intention is to maintain the maximum pressure at a definite figure so as to allow the construction of relatively light-weight oil engines. It is said that the maximum-pressure principle allows the building of engines of approximately the same weight per horsepower as steam engines.

Parish & Tewksbury, Inc., New York, N. Y., has had executive charge of the development of this engine and plans to present the results of the test performances before the winter meetings of several engineering societies.

AUTOMOTIVE PRODUCTION

Abstracts

from other publications

Training Automobile Mechanics

The maintenance division of the automotive industry, the largest manufacturing industry in the world, has always been hampered by a shortage of good mechanics. J. F. McDonald says that little has been done to remedy this condition, and we go on holding the hope that when the time comes some miracle will supply our need of men. Believing that opportunities exist in the maintenance division of the automotive industry that are stepping-stones to positions of unlimited possibilities if the applicants possess the necessary education and desire for advancement and that the industry should accept the responsibility of systematically educating men to fill these positions, the author outlines the advantages of the apprenticeship system and explains the results accomplished during the last 9 years in the mechanical schools conducted by the Ohio Buick Co., with which he is associated.

The course of study is described, the topics covered are set forth, and the progress of the student is followed as he advances from one department to another. The importance of the proper selection of candidates and of attention to the family connections, education, companions and habits of the young men is stressed and the benefits that will accrue to those who complete such a course are emphasized. Having been used for years by railroad and contract shops in developing their men, the apprenticeship method, in the opinion of the author, is one of the many good things worked out by other industries that might be transplanted into the automotive industry with far-reaching benefits.—*Journal of the Society of Automotive Engineers*, Aug. 1925, p. 202.

Training Machinists

The Reo Motor Car Co. of Lansing, Mich., conducts extensive courses that give their apprentices a well-rounded education in the machinist trade and trains them definitely to become either toolmakers or to fill positions in the manufacturing departments. The number of apprentices is limited to 200, and the classes are formed at any time in order to keep the number as close as possible to the maximum. There are always more than 150 live applications on hand from which classes can be formed when others graduate or when a sufficient number of vacancies occur. In the three years that have elapsed since applications were first filed, there have been 982 applications. Young men up to 25 years of age may learn a trade. One class is open to young men from 21 to 25, who have gone through eight or more grades of school. The length of the course is 2 years and the wage is 40c. an hour. The next class is for young men from 18 to 21, who are high school graduates, and lasts for 2½ years. The third is for boys from 16 to 21 lasting for four years. The wage for this last class runs from 22½c. to 40c. an hour. Out of 190 apprentices enrolled at present 94 are in the senior group and 75 are high school graduates. The applicant serves a probation period of three months before indentures are signed. A period is given to instructions in drafting and the laying out work. The point is not to develop draftsmen but to train them in reading blueprints. New boys are first sent to the apprentice machine shop. This shop makes repair parts for cars of old design and about eight boys are kept busy on making machine repair parts. Special machines are sometimes built here, and frequently stock production work is routed through this shop. Another use for this apprentice department is that the boys from it can fill the place of any absent men and thus keep the operation of the shop up to normal.

The officials of the company have great faith in the apprentice department as is shown by the fact that many of their sons have graduated from the course and are working in the shop.—*Machinery*, July, p. 847.

Ford Salvage

George Hagemann discusses the method of salvage in the Ford plant where $15,000,000 was the net sum realized during 1924 from the by-products business of the Ford Motor Co. This amount was saved entirely by the re-utilization of tools and miscellaneous equipment, the recovery of useful products from waste materials and by the sale of unusable residue as scrap. This salvage work receives the co-operation of the entire plant and, in passing, Mr. Hagemann notes that in the whole factory every workman is steadily busy and appear to enjoy his work.

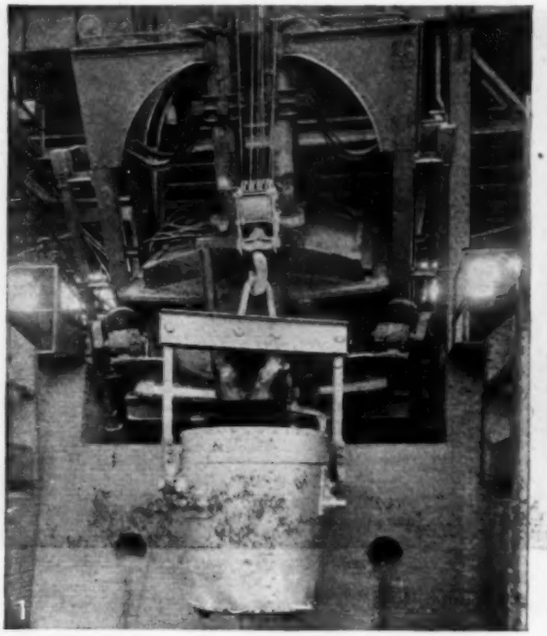
The attitude does not appear to be an artificial one nor enforced by any stringency of management.

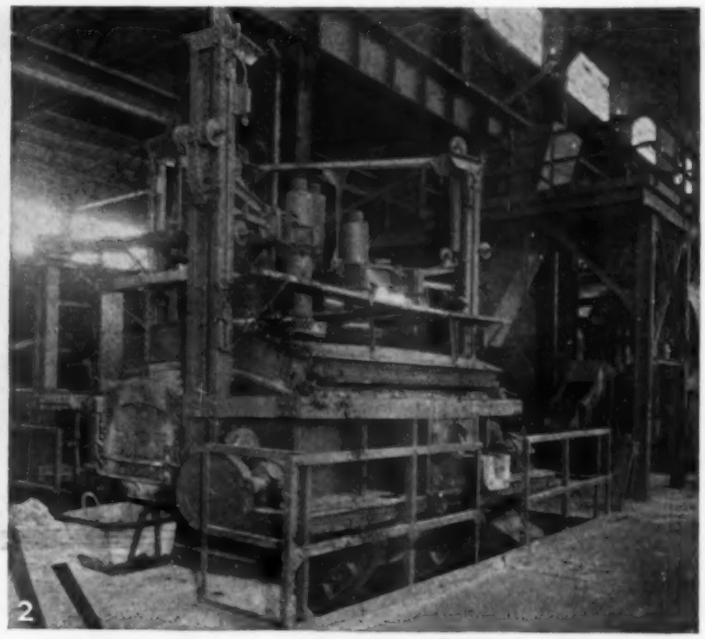
There are 464 men engaged directly in salvage work at Highland Park, 65 are scattered throughout the plant at baling machines and 400 are in the building for lumber reclamation. There are 139 more engaged at River Rouge. Many of these men are crippled in some way so that they are unable to perform production tasks but are utilized in the salvage department.

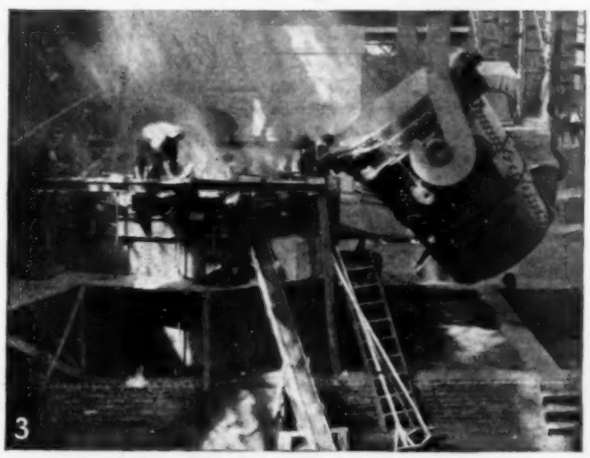
All obsolete and worn materials and all scrap and refuse of every kind go to the salvage department. The material salvaged ranges from floor sweepings, odds and ends of wood, metal turnings and the like, to entire buildings and equipment.

Many of the small tools are reclaimed; for example, dies for the forming of rolled threads are first annealed and new threads cut, and after hardening they are ready to go back into service. Broaches are made from hammered steel. When worn down they are reground on the front edge so long as enough backing stock exists. When this method reduces them below tolerance limits they are re-worked to smaller sizes. Finally they are re-melted to be made into bar stock again. Drills are usually reground to a smaller size. It has often been possible to re-work a drill so it will perform two operations instead of one, hence saving in production cost. Some of the drills are fitted for service again by retanging. Reamers are usually reground for slightly smaller jobs, though they are sometimes up-set and reworked either to the original size or larger. Both drills and reamers when finally used up are scrapped.

This article is the first of two dealing with salvage. —*Management & Administration*, June, p. 557.







Electric Furnaces in a Motor Shop

1—Tipping for pouring.

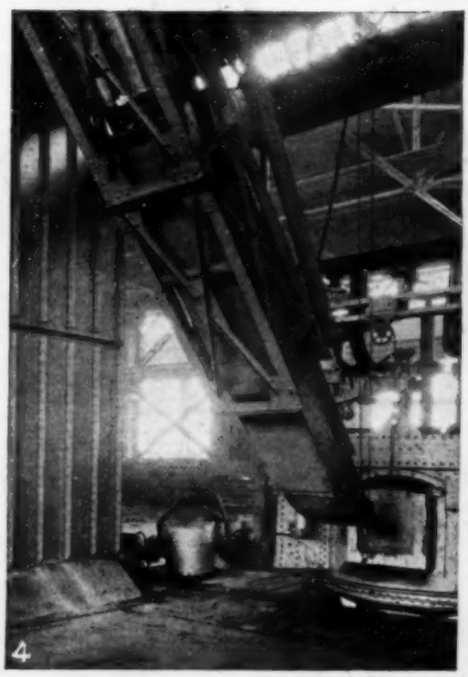
2—One of the 50-ton furnaces.

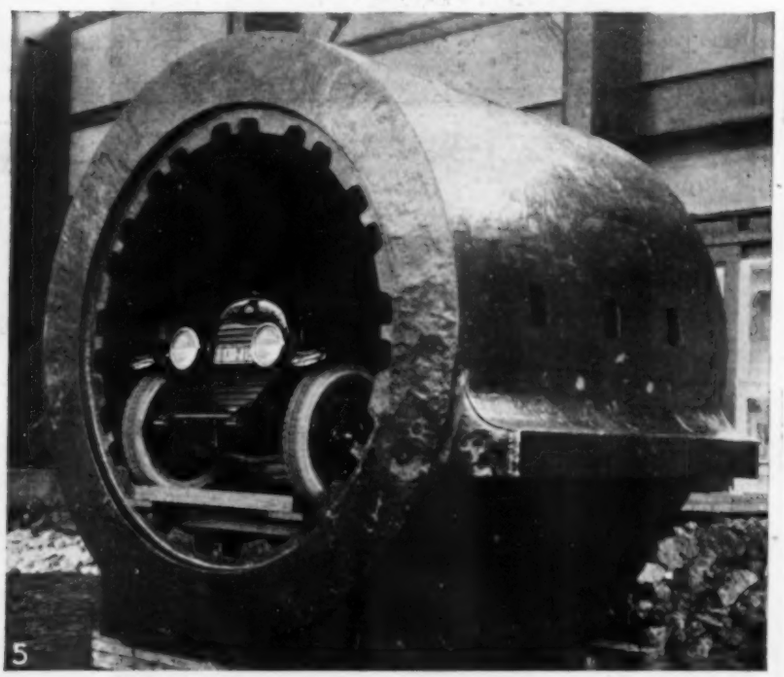
3—Pouring a 96-ton turbine casting.

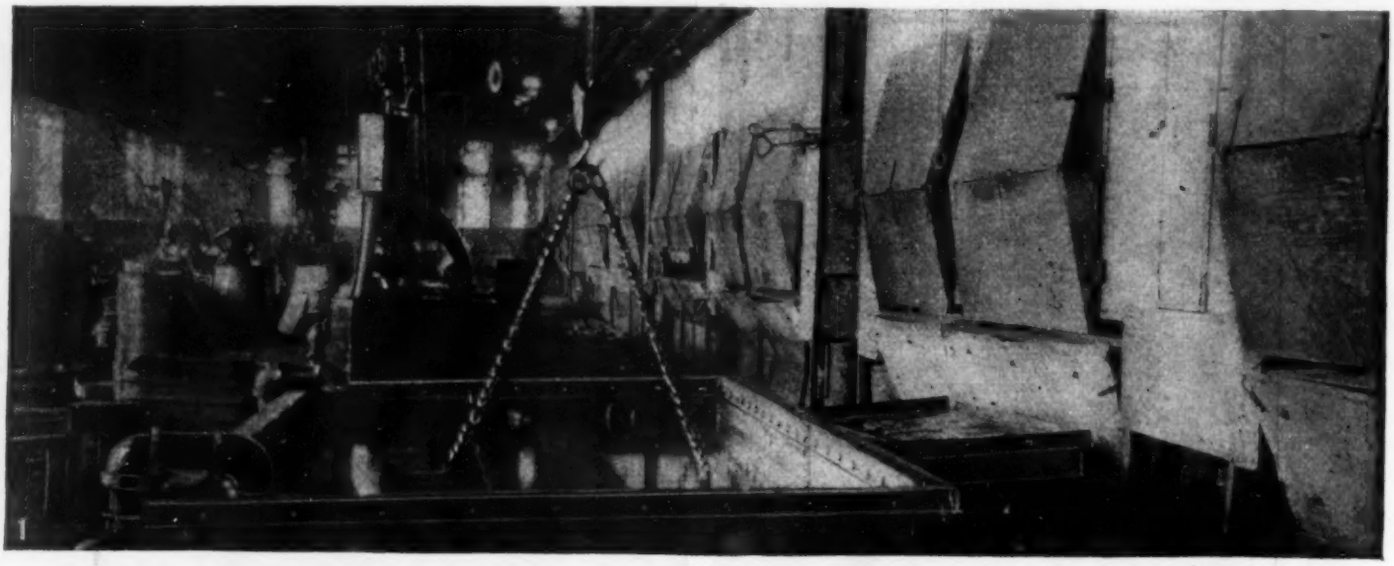
4—Charging with a conveyor.

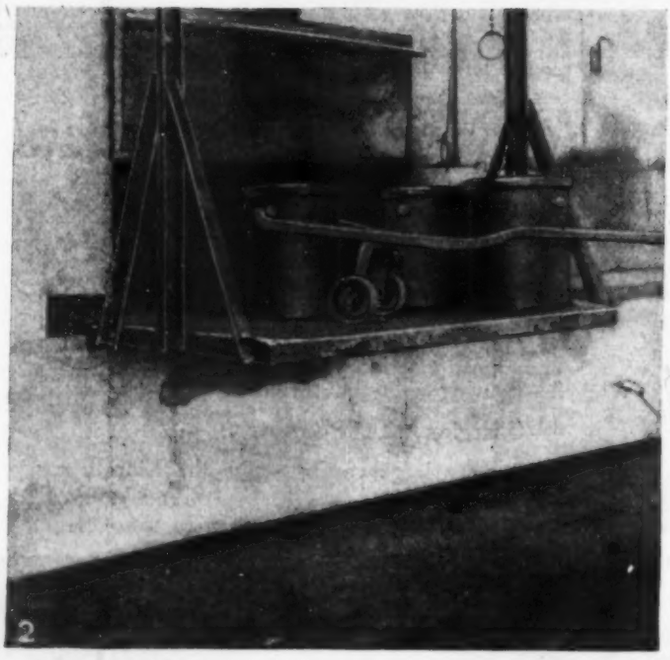
5—A very large casting—note the Lincoln car inside.

Photographs by courtesy of the Ford Motor Co.

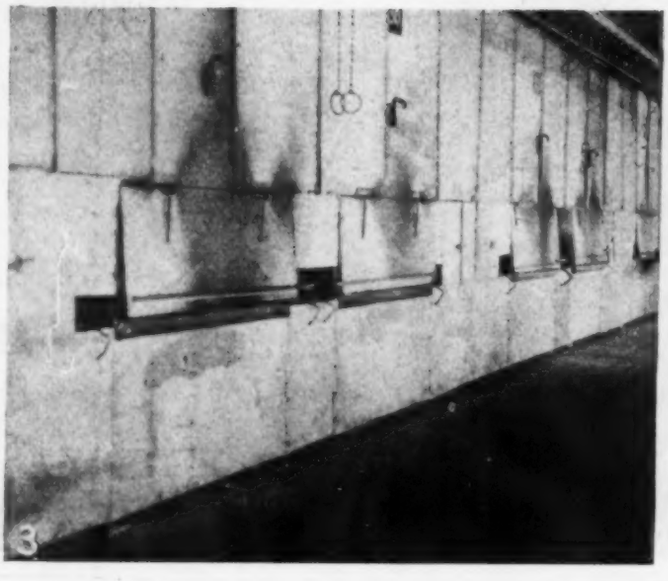


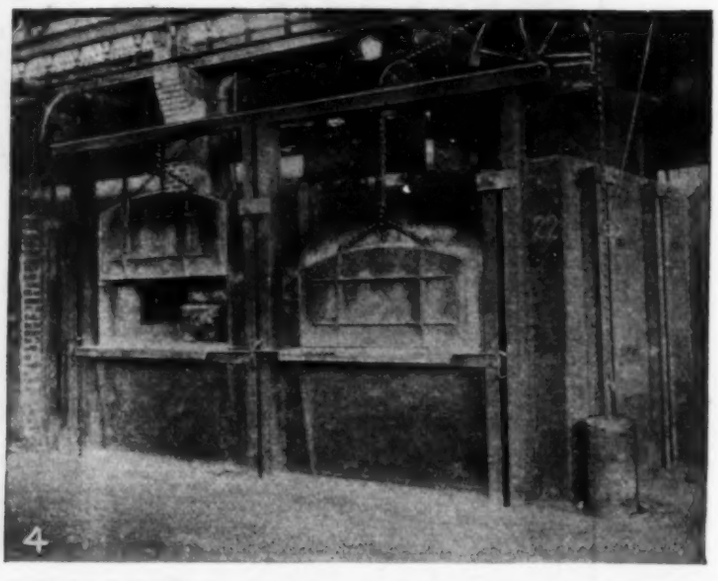


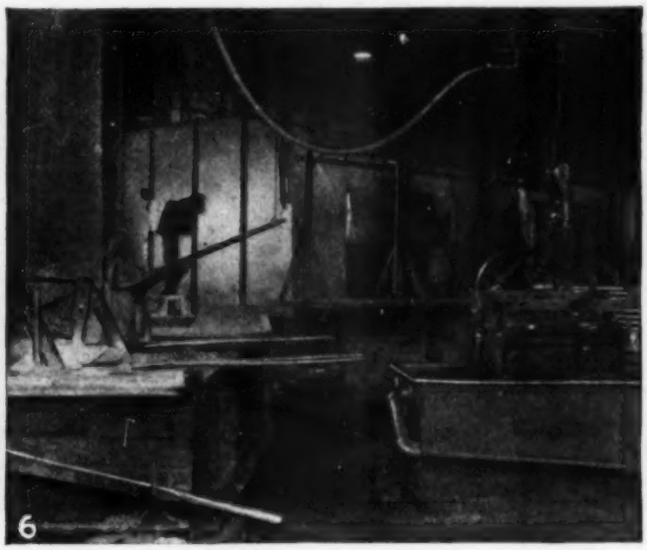




Heat-Treating Equipment Used for Mack Truck and Bus Units







1—General view of the south side of the heat-treating department.

2—Method used for leading pots into the furnaces.

3—Furnaces located on the north side of the department. The hooding of the furnaces has increased the working efficiency of the department through the reduction of the room temperature from 130 to 96 deg.F. in the summer months.

4—A view of the furnaces before they have been hooded.

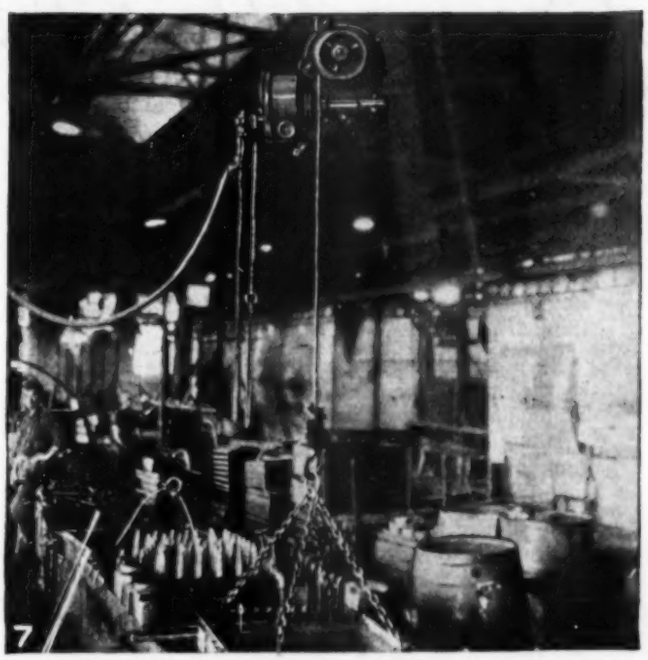
5—Work located in one of the furnaces showing the construction of the hooding at the doors.

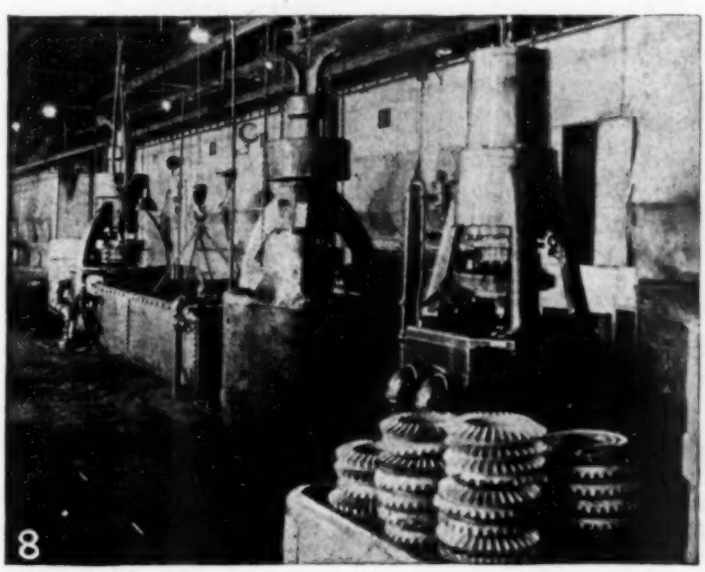
6—Two of the cyanide pots and quenching equipment.

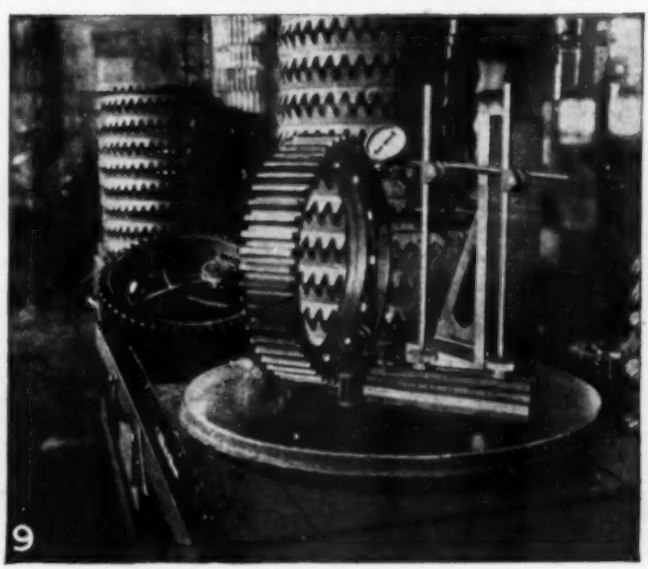
7—One of the many air-operated hoists used for lifting purposes.

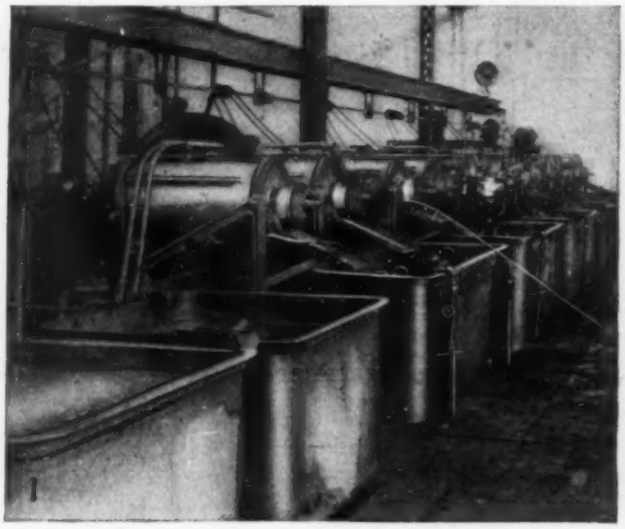
8—The gear hardening machines used for bevel and spur gears.

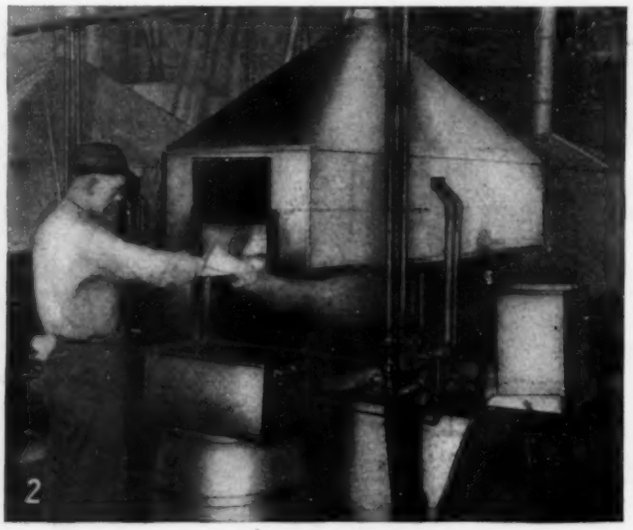
9—Inspection equipment for testing squareness of gear face with the teeth after heat-treatment.











Gas-Fired Heat-Treating Equipment

1—A battery of carbonizing machines used for a variety of small work.

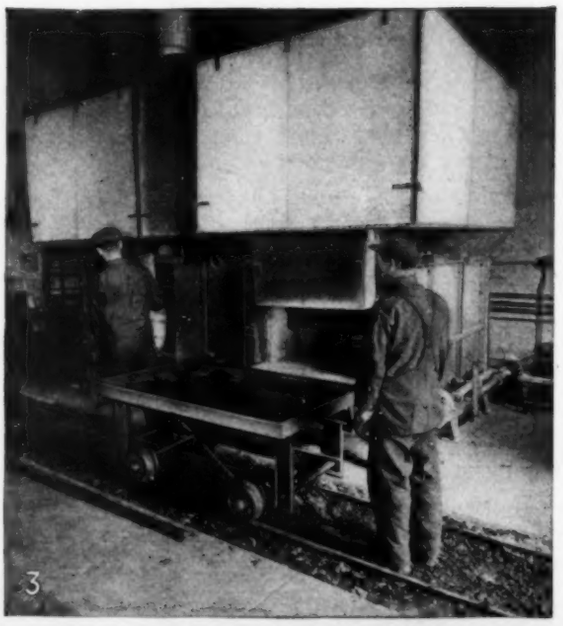
2—Heat-treating equipment for hardening small washers. The work is scooped into the furnace and is automatically carried through and passed out into the quenching tank at the right.

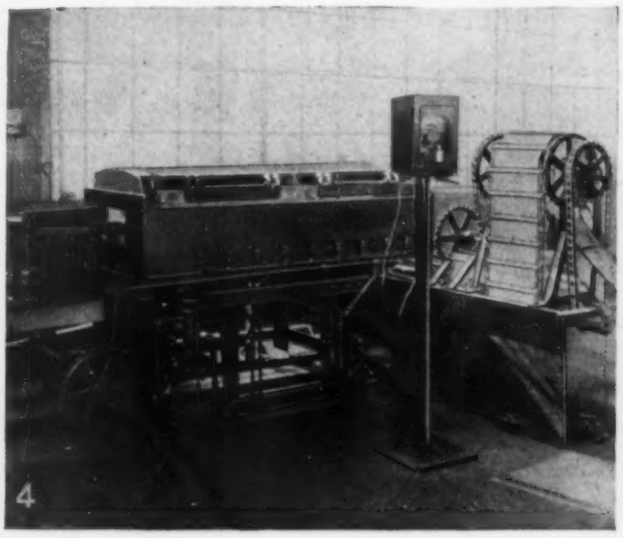
3—Gas-fired annealing furnaces operated by automatic control, the heat being held at plus or minus five degrees.

4—Automatic heat-treating machine of the shaker-hearth type. Parts are placed on the oscillating pan, carried through the furnace, quenched in the tank and automatically carried out of the tank into baskets. The temperature is automatically maintained.

5—Vertical-type carbonizing furnace used for printing-press rolls. Three rolls are placed into separate Nicrome retorts, and raw, unburned city gas is admitted as the carbonizing agent. Quenching is accomplished in ice water. By this method, the work is produced free from scale.

Photographs by courtesy of the American Gas Association





Recent Practice on Locomotive Axles Crankpins and Piston Rods

Alloy and carbon steels and the heat-treatments used on some railroads—Hollow axle and crankpin practices and dimensions — Press fits on locomotive work

Special Correspondence

THE increasing use of alloy steel for such locomotive parts as axles, crankpins, connecting and side rods, has made it necessary for the railroad shop to become better acquainted with heat-treating methods. One result is that more attention is being paid to the methods used in heating and in handling steels for railroad use. On some roads, no heating or reforging of alloy steel is permitted, except at the main shops, where both facilities and experience insure the steel against injury.

Greater care is also being exercised in handling the carbon steels used for axles, rods, and pins. Open-hearth steel is usually specified, with carbon ranging from 40 to 55 points and manganese in somewhere near the same proportions, though sometimes as high as 70 points. The tensile strength is about 80,000 lb. and the yield point must be at least 40,000 lb. Carbon steels must be annealed. They must first be allowed to become cold after forging, and then be reheated to the temperature that will refine the grain and then allowed to cool slowly without quenching or artificial cooling of any sort.

On one road, the annealing temperature is from 1,425 to 1,475 deg. F. Main crankpins and forgings of that size, or larger, are held at that temperature for not less than 3 hr. and are then allowed to cool slowly without being removed from the furnace.

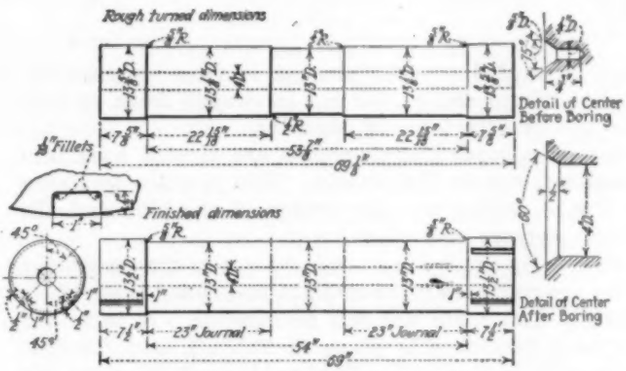


Fig. 1—Hollow driving axle

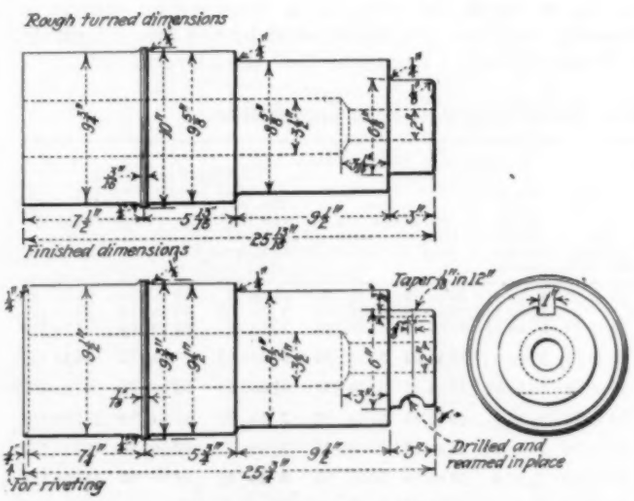


Fig. 2—Bored crankpin

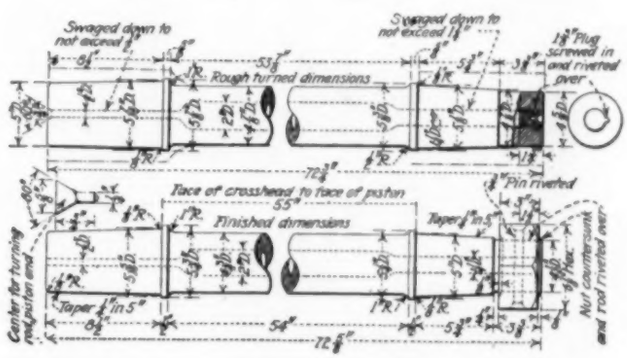


Fig. 3—Hollow piston rod details

Carbon-vanadium steels, containing a small amount of chromium, are made by either the open-hearth or electric furnace process. They are also allowed to cool after forging and are then normalized by being heated to from 1,600 to 1,650 deg. F., which corresponds to a vey light cherry color, or free scaling heat. Satisfactory grain refinement can be obtained at a somewhat lower temperature, if the forgings are held at that temperature for several hours. Quenched and tempered forgings are not accepted by some railroads. Other alloy steels are used by some roads.

The use of hollow crankpins and axles is growing, the practice of one of the large roads being seen in Figs. 1 to 3. When the outside diameter exceeds 7 in., the pins or axles are frequently hollow forged, while on smaller parts, such as piston rods of 4 in. or over,

the holes are bored from the solid. In axles, the holes are straight through the piece, as in Fig. 1, but in crankpins the hole is of two diameters, as in Fig. 2. In piston rods, the maximum-diameter holes are bored through the rods and the rods swaged down at each end as in Fig. 3. These illustrations give all the main dimensions and will serve as guides to modern practice. On other roads the walls of the axles are 3½ in. in thickness; crankpins from 2⅞ to 2⅞ in.; and of piston rods 1¾ inches.

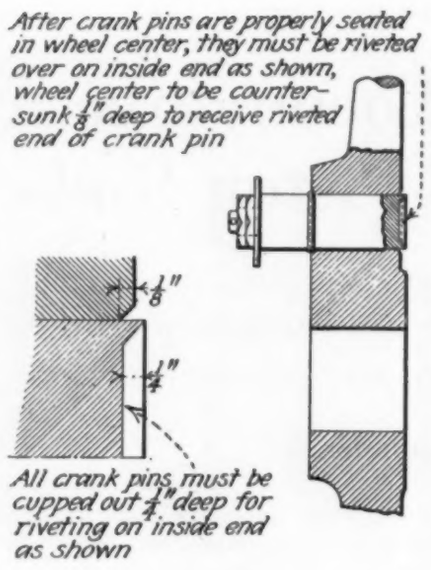

After crank pins are properly seated in wheel center, they must be riveted over on inside end as shown, wheel center to be counter-sunk ⅛" deep to receive riveted end of crank pin
⅛"
¼"
All crank pins must be cupped out ¼" deep for riveting on inside end as shown

Fig. 4—How crankpins are riveted over

Rough-turned forgings allow ⅛ in. on the surface for finishing, or ¼ in. in diameter. Railroads use the 60-deg. center for all forgings except driving axles. On driving axles, specifications usually call for a 77-deg. center, although some roads use 75 deg., as in Fig. 1. After boring, a 60-deg. angle is provided as shown in the detail. Fig. 1 also shows the keyseat dimensions, including the ⅛-in. fillets in the corners.

This figure also shows the small amount of space left in the center of the axle by the long driving-box bearings now in use. With bearings approximately 23 in. long, there is but 8 in. left in the center, making it necessary to use some form of outside valve gear. There is no longer room on the axle for eccentrics, even if the wheel spacing permitted getting under the engine without a pit.

Table I—Crankpin Pressure Fits

Dia. of Pin Fit in Wheel Centers (Inches)	Tons Pressure Wheel Centers	
	Cast Iron	Cast Steel
3 — 3¼	15 to 20	24 to 32
3¼— 4	20 to 25	32 to 40
4 — 4¼	25 to 30	40 to 48
4¼— 5	30 to 35	48 to 56
5 — 5¼	35 to 40	56 to 64
5¼— 6	40 to 45	64 to 72
6 — 6¼	45 to 50	72 to 80
6¼— 7	50 to 55	80 to 88
7 — 7¼	55 to 60	88 to 96
7¼— 8	60 to 65	96 to 104
8 — 8¼	65 to 70	104 to 112
8¼— 9	70 to 75	112 to 120
9 — 9¼	75 to 80	120 to 128
9¼—10	80 to 85	128 to 136
10 —10¼	85 to 90	136 to 144

A modern crankpin with a pinned collar instead of a nut, is shown in Fig. 2. A square, taper key prevents the collar from turning, while a pin, the hole for which is drilled and reamed with the collar in place, prevents end movement.

Table III—Press-Fit Allowances for Crankpins

Size of Hole "C" (Inches)	Size of Pin	
	Steel Wheel (Inches)	Cast Iron Wheel (Inches)
3 to 5	"C" + .014 to .017	"C" + .012 to .014
5¼ to 7	"C" + .017 to .020	"C" + .014 to .016
7¼ to 9	"C" + .020 to .025	

Hollow piston-rod practice is shown in Fig. 3. The piston end has a nut, held in place by a ⅜-in. pin, that is riveted into coned recesses in the sides of the nut. The hole in the piston end is plugged to prevent steam from blowing through the rod. The plug is riveted over to prevent it from unscrewing. The crosshead end of the rod is swaged down so that the hole is only ½ in. in diameter.

Table IV—Press-Fit Allowances for Axles

Size of Hole "A" (Inches)	AXLES Size of Axle	
	Steel Wheel (Inches)	Cast Iron Wheel (Inches)
6 to 7	"A" + .013 to .015	"A" + .011 to .013
7 to 9	"A" + .015 to .018	"A" + .012 to .014
9 to 11¼	"A" + .017 to .020	

On some roads the crankpins are riveted over into coned recesses in the wheels. This practice is shown in Fig. 4, where the dimensions of the pins and the wheel recesses are given.

In making press fits on either axles or crankpins, the holes are supposed to be straight and round their whole length. Taper fits are not permissible. A table for crankpin pressures is given in Table I, and for axle pressures in Table II. Tables III and IV show the amount the crankpins or axles must exceed the diameter of the holes to secure the desired fit. The practice is to turn the pins to a nominal or standard diameter, and bore the holes *small* by the amount given in Tables III and IV, which show the allowances.

Table II—Pressure Fits for Axles

Size of Axle Diameter of Journal (Inches)	All Car, Loco. Tender and Steam Crane Wheels: Kind and Weight of Wheel	Tons Pressure Required Min.	Tons Pressure Required Max.	Locomotive Front Truck Wheels: Dia. of Axle Fit in Wheel Center (In.)	Tons Pressure Required Wheel Centers: Cast Iron	Tons Pressure Required Wheel Centers: Cast Steel	Locomotive Driving and Trailer Wheels: Dia. of Axle Fit in Wheel Center (In.)	Tons Pressure Req'd Wheel Center: Cast Iron	Tons Pressure Req'd Wheel Center: Cast Steel
3x5, 3½x5	Cast iron 625	25 to 30		4 to 4½	25 to 35	35 to 50	4½ to 5	40 to 54	58 to 80
3½x6, 3½x7	lbs. and upward			4½ to 5	30 to 40	40 to 55	5 to 5½	45 to 60	72 to 100
3½x7	Cast iron 625 to 775	30 to 45		5 to 5½	30 to 45	45 to 60	5½ to 6	49 to 66	79 to 110
	Steel tired and rolled steel	45 to 60		5½ to 6	35 to 50	50 to 70	6 to 6½	54 to 72	86 to 120
4x7, 4x8	Cast iron 625 to 775	35 to 50		6 to 6½	35 to 55	55 to 75	6½ to 7	58 to 78	94 to 130
4½x8, 4½x8½	Steel tired and rolled steel	50 to 70		6½ to 7	40 to 60	60 to 80	7 to 7½	63 to 84	101 to 140
4½x8½	Cast iron 675 to 775	35 to 50		7 to 7½	45 to 65	65 to 85	7½ to 8	67 to 90	108 to 150
	Steel tired and rolled steel	50 to 70		7½ to 8	50 to 70	70 to 95	8 to 8½	72 to 96	115 to 160
5x9	Cast iron 650 to 775	40 to 60		8 to 8½	50 to 70	70 to 95	8½ to 9	76 to 102	122 to 170
	Steel tired and rolled steel	60 to 80		8½ to 9	55 to 75	75 to 100	9 to 9½	81 to 108	130 to 180
5½x10	Cast iron 700 to 750	45 to 65					9½ to 10	85 to 114	137 to 190
	Steel tired and rolled steel	65 to 85					10 to 10½	90 to 120	144 to 200
6x10	Cast iron	50 to 70					10½ to 11	94 to 126	151 to 210
6x11	Steel tired and	70 to 95					11 to 11½	99 to 132	158 to 220
6½x11	rolled steel						11½ to 12	104 to 138	166 to 230
							12 to 12½	109 to 144	173 to 240
							12½ to 13		180 to 250
							13 to 13½		187 to 260

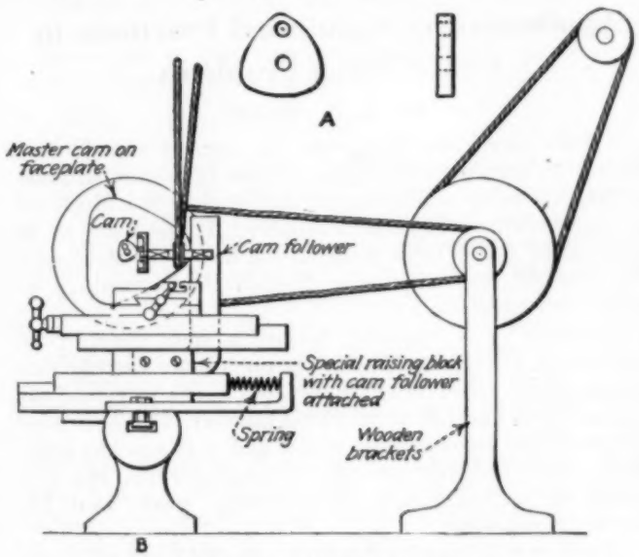
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Grinding Heart-Shaped Cams

BY C. L. HALL

Some time ago we received an order for a small quantity of heart-shaped cams, as shown at *A*, to be made of tool steel, hardened, and ground on the periphery to very accurate dimensions. We could produce the cam surface on the profiling machine readily enough but the grinding operation was a real problem, since the small quantity involved did not warrant the purchase of a cam-grinding machine. The method used is illustrated at *B*, which shows a bench lathe, temporarily altered for this job. We made a master cam considerably larger in diameter than the cam to be ground and fastened it to the faceplate. On the master cam was mounted the small cam to be ground. We removed the feed screw from the lower part of the cross-slide and attached a block carrying a steel piece to act as a cam follower. A spring was arranged to press against the cross-slide and keep the follower against the master



Rigging for grinding the cams

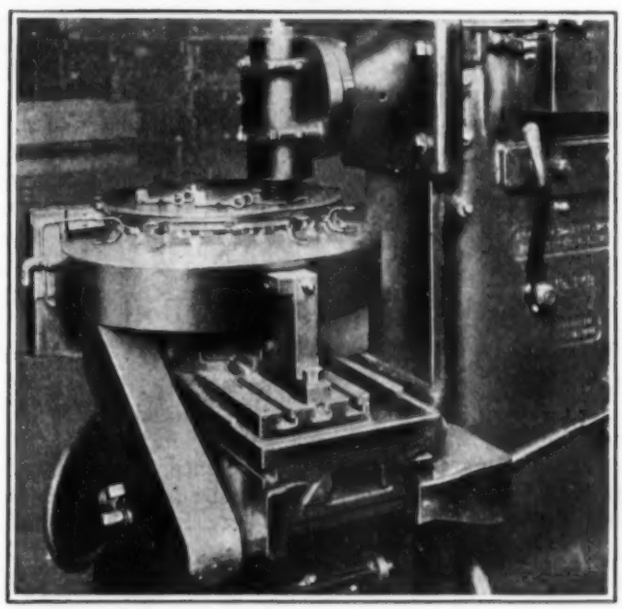
cam at all times. A compound rest, mounted as shown, carried a toolpost grinder and provided a means for feeding the wheel in both directions. The headstock of the lathe was blocked up to the proper height to bring the spindle on the same center line as that of the grinder spindle. We also made a countershaft with two wooden pulleys to reduce the speed of the lathe spindle. The countershaft was mounted on wooden brackets screwed to the bench.

The grinding was done with the edge of a cup wheel, and was as satisfactory as it would have been if done on a machine costing several thousand dollars. While the equipment was intended to produce but a small quantity, it has proved sufficiently long-lived to be of service on several lots since the first order, and the wooden bearings of the countershaft are still in good condition.

An Unusual Milling Job

BY R. E. MARKS

A rather unusual milling job in the shops of the Western Electric Co., Hawthorne, Ill., is shown in the accompanying illustration. The special circular milling fixture shown is mounted on the table of a new motor-in-the-base Brown & Sharpe machine. The circular



A continuous milling fixture

motion is secured through a chain driven by worm gearing that obtains motion through the cross shaft on the end of the table.

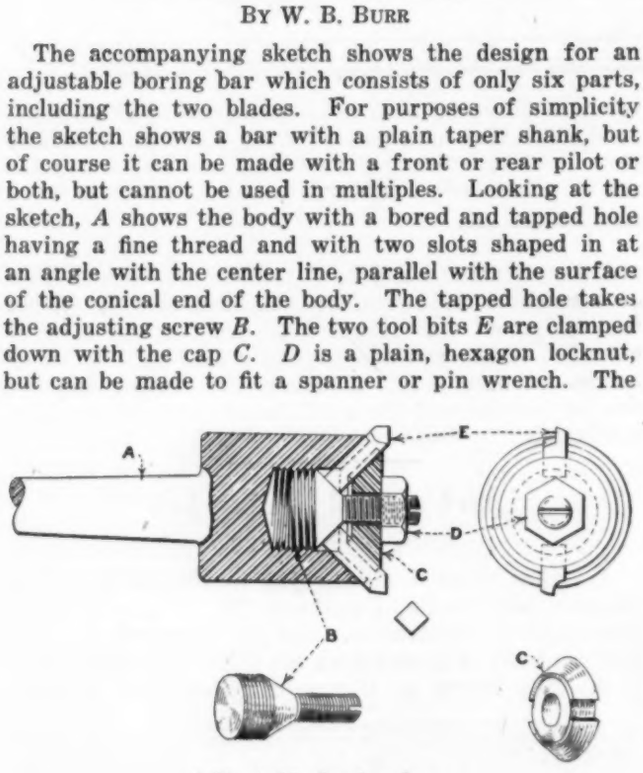
The straddle-milling cutters that face both sides of the bearing ends of the telephone hooks are hidden beneath the guard plate over the work. The hooks are inserted in the proper openings and clamped before they reach the milling cutters, being automatically released in time for removal and the insertion of another piece. The rapidity with which these pieces can be handled is indicated by the net production of 1,120 hooks per hour.

IDEAS FROM PRACTICAL MEN

An Adjustable Boring Bar

By W. B. Burr

The accompanying sketch shows the design for an adjustable boring bar which consists of only six parts, including the two blades. For purposes of simplicity the sketch shows a bar with a plain taper shank, but of course it can be made with a front or rear pilot or both, but cannot be used in multiples. Looking at the sketch, *A* shows the body with a bored and tapped hole having a fine thread and with two slots shaped in at an angle with the center line, parallel with the surface of the conical end of the body. The tapped hole takes the adjusting screw *B*. The two tool bits *E* are clamped down with the cap *C*. *D* is a plain, hexagon locknut, but can be made to fit a spanner or pin wrench. The



Adjustable boring bar

adjustment of the blades is rather obvious and is accomplished by slightly loosening the locknut and turning the adjusting screw *B* in or out with a screw driver. Of course when screwing in, the blades must be pressed back.

Reducing an Oversize Bolt

By R. B. Ware

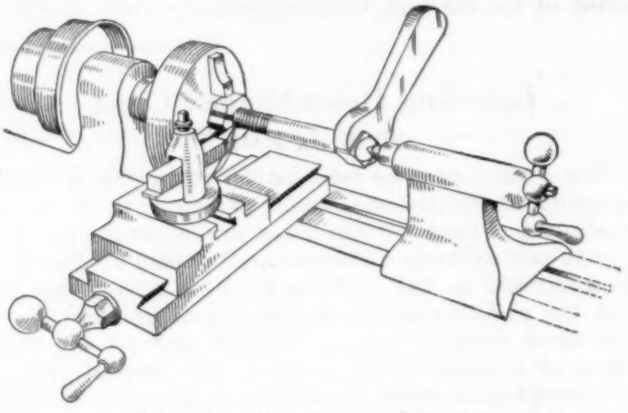
The sketch shows how the writer reduced the size of thread on a special bolt when neither threading die nor screw-cutting lathe were available. The bolt was a replacement part, sent from a distance, but through somebody's miscalculation proved to be just a trifle too large to screw into the place where it was expected to go.

I procured a hexagon nut of the same nominal size and pitch as the threaded portion of the bolt, sawed it through on one side and sprung it open until the bolt would screw into it. Selecting a filler piece for the saw-kerf that was just thick enough to prevent the nut from closing tightly on the bolt when it was clamped in the lathe chuck, I put the parts in the chuck, as shown in the sketch, with the bolt screwed into the nut to the limit of the thread.

The live spindle of the lathe was then clamped tightly so that it could not turn, and the tail center brought up to meet the center in the head of the bolt. The tailstock was clamped very lightly, so that when the bolt was unscrewed from the nut by means of a wrench, the tailstock would be pushed back along the shears.

A threading tool was then set into the toolpost and adjusted to the thread of the bolt as close to the nut as conveniently possible, and, turning the bolt backward with the wrench, the tool was fed in to take a thin shaving over the thread as it was withdrawn from the nut.

The cut could not, of course, be carried to the extreme end of the bolt, as it was necessary to leave a thread



How the thread was shaved

or two in the nut for a guide; but the bolt was long enough so that a couple of threads could be sawed off the end without affecting its usefulness. This expedient obviated a vexatious delay that would have been incurred in sending the bolt back to be corrected.

Application of Continued Fractions to Gear-Cutting Problems

By R. B. Willis

Inconvenient fractions can be approximated very closely by putting them into the form of continued fractions, and using a convergent that is close if considered as a percentage, and also available. If the work to be done is of fairly large dimensions, however, there may be need of correction even though the percentage of error is very small.

Suppose it is required to cut a spur gear of 16 diametral pitch with 479 teeth, on a gear cutting machine whose index worm makes 144 turns to rotate the index wheel one full turn. This number, 479, is beyond reach of the index change gears, and it is a prime number. Therefore the correct change-gear ratio, 144/479, must be approximated, using change gears that are with the machine.

Putting the fraction 144/479 into the form of a continued fraction by the method described on page 25, Vol. 63, of the *American Machinist*, the convergents are found to be $\frac{1}{3}$, $\frac{46}{153}$, 46/153, and 49/163. The convergent 49/163 is beyond reach because it contains a prime number 163, and the machine change gears probably will not run higher than 97 teeth.

The next earlier convergent, 46/153, can be factored to read $\frac{1}{3}$x46/51, which is within the range of the change gears. Dividing the approximate ratio, 46/153, by the correct ratio, 144/479, will show whether the 479 indexings needed to complete the gear will add up

IDEAS FROM PRACTICAL MEN

to more or to less than one turn of the index wheel, or, what is the same thing, to more or to less than the full distance around the pitch circle of the gear to be cut.

The fraction 46/153 divided by 144/479 equals 22034/22032, which shows that the 479 indexings will carry the index wheel around more than a full turn, the error being 2/22032, or 1/11016 of the distance around the pitch circle of the gear to be cut.

Correcting the Error

Stated as a percentage, this error is less than 1/100 of 1 per cent, which looks small enough. But the circumference of the pitch circle is 94.05165 inches, and the accumulated error will be 1/11016 of the circumference, or more than 0.0085 in. So great an error cannot be ignored, and must be corrected by moving the cutter sidewise at intervals frequent enough to keep the accumulating gain down to a thousandth of an inch.

It will be near enough to call the total error 0.009 in., and to move the cutter 0.001 in. at intervals of 1/9 of the way around. The ninth movement of 0.001 in. need not be made except to check the result, or unless for any reason it is desired to cut around again.

This method prevents the cutter from being more than 0.001 in. out of correct position at any time if it is kept clearly in mind which way to move the cutter. Since this gear will go too far around, by 1/11016 of the circumference, the cutter must be moved in the same direction that the rim of the gear goes when indexing takes place. By imagining the cutter moving instead of the gear, and realizing that the cutter, if moving, would go too far, it will be seen that moving the cutter in the direction that the rim goes is the same as retarding the cutter.

Another Danger

The other errors introduced by moving the cutter so little as 0.009 in. off center and by moving it along a straight line instead of along the circumference of the pitch circle will have no measurable effect upon the depth of the spaces nor upon the form of the teeth. The only danger is that, unless great care is taken, the movements of the cutter may add up wrong. It is better to measure the settings of the cutter, as 0.001 in., 0.002 in., from the original setting rather than to depend on moving the cutter the right distance by lines on a dial.

The settings should be made by moving the cutter-arbor slide, and not by putting washers on the cutter arbor, because the cutter seldom runs exactly true on its arbor, and the depth of the spaces might vary too much if the cutter were loosened and tightened again.

It is important to adhere to the figures absolutely, for if the job is run at production speed the rim of the gear will get warm, and if the workman tries to check his settings by spaces already cut, his nerve may be shaken.

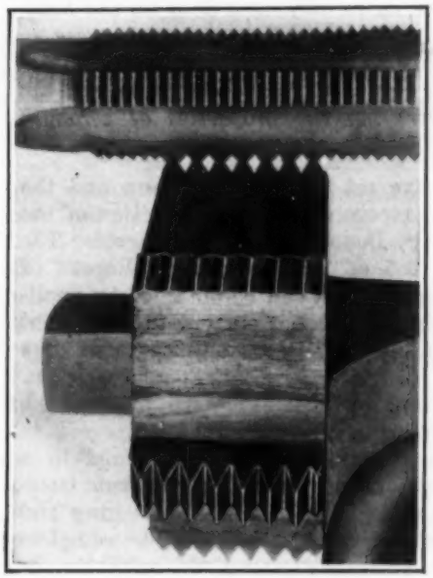
A slide-rule artist would not go to the trouble of figuring through a continued fraction. He would set up 144/479 and pick off a ratio that looked about right He would have to compare it with the original, however, to check his setting.

Tool for Chasing Threads

By John Strama

The illustration shows a thread chaser in position for cutting the threads on a tap. The chaser is in the form of a milling cutter, though it does not revolve, but is held on a bar in the toolpost of a lathe.

The cutter has but half the number of teeth of the work to be threaded, and for right-hand threads it should be cut left-hand, so that the teeth in engagement will present an angle corresponding to the helix angle of the thread being cut. The reason for having a less number of threads than those of the work is to give more chip room and thus avoid tearing the tops of sharp threads.



A thread-chasing tool

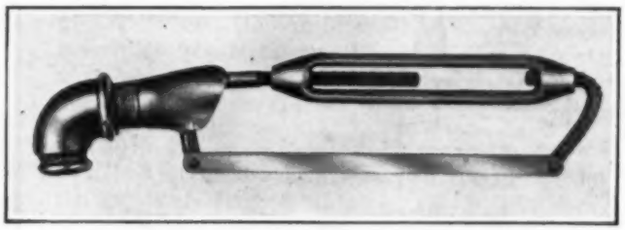
By the use of this chaser we have been able to materially reduce our threading time.

An Improvised Hacksaw Frame

By I. B. Rich

One of the extremes, either of necessity or ingenuity, to which some railroad shops have been compelled to resort in the past, is indicated by the hacksaw frame shown herewith. This frame was found by one of the men of the Westinghouse Air Brake Co., in an out-of-the-way railroad shop and photographed as a curiosity.

An elbow and a short piece of pipe, the latter flattened at the end to hold a threaded rod and a carrying



An unusual hacksaw frame

projection for the saw blade, formed the handle. The outer end of the blade was held by a threaded rod bent to enter one end of the turnbuckle. Adjustment as to length was secured by turning the turnbuckle, and covered quite a range of blade lengths. While neither light nor convenient the frame served its purpose, even though more expensive than a new one.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Warping Strains in Brass Tubing

Q. Can you direct us to authentic data on the heat-treatment of brass tubing to relieve internal stress so that we will not have to contend with warping of our raw material? We desire to heat-treat to relieve the stress without destroying the properties of strength and hardness.

A. A comprehensive set of tests were run and the data were published recently under the direction of the Bureau of Standards, Department of Commerce. The publication is No. 285 of the Technologic Papers of the Bureau of Standards and can be obtained by application to the Superintendent of Documents, Government Printing Office, Washington, D. C., and payment of a nominal charge of 15 cents.

A number of important points were ascertained, among them the following:

"Internal stress can be removed rapidly and to a very large extent by heat-treatment in a moderate time-temperature range which will not effect softening and recrystallization but recrystallization must be complete before the stress is entirely removed.

"Brass tubing which has been reduced from about 17 to 56 per cent in the cold can be heated over a fairly wide time-temperature range without loss in hardness but with substantially complete release of longitudinal internal stress.

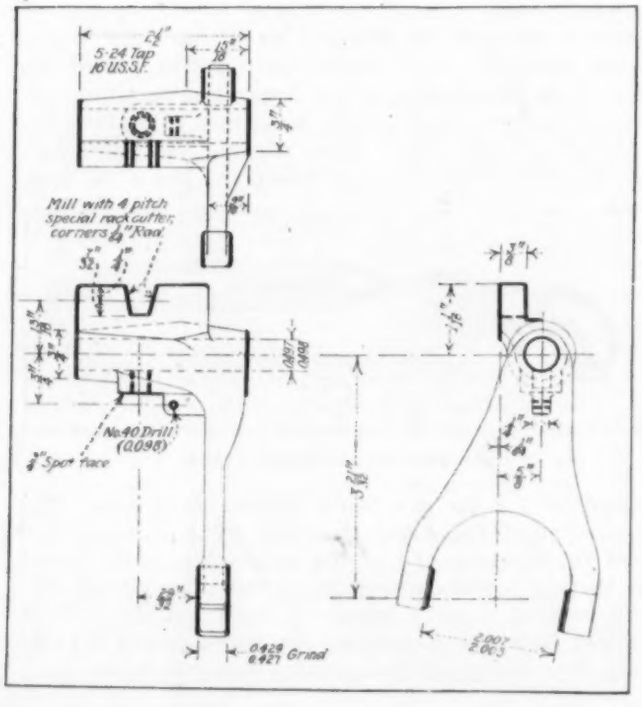
"Cold-drawn brass tubes may be heat-treated in certain temperature ranges (at about 300 deg. C.) for the removal of internal stress without injury to the mechanical properties, and, in fact, by accurate control of manufacturing operations and the subsequent heat-treatment the stress may be very largely removed with simultaneous improvement in the mechanical properties.

"In the brass tubes examined, the major internal stresses are longitudinal, the stress appearing to be distributed as follows: The stress in the wall of the tube in a direction toward the internal surface is a longitudinal tensile stress while that in a direction toward the internal surface is a longitudinal compressive stress.

"Accelerating cracking agents, such as mercurous nitrate, do not detect the presence of a stressed condition in worked brass unless the initial stress is above a certain limiting value, or of a definite nature."

$50 Apiece for the Best Two Solutions

The Third Prize Problem



OPEN to all readers of the *American Machinist*. Answers must be mailed by Nov. 12, midnight. Judges—editors of the *American Machinist*. The two winning solutions will be published with the announcement of the winners. Other good solutions will be published and paid for at space rates, the names of authors to be withheld if they so desire.

Send your solution to Practical Shop Problems Editor, *American Machinist*, 10th Ave. at 36th St., New York City. Put your full name, title and company name on your answer in such a way that this information can be detached and a key number substituted.

Don't wait until the last minute to send in your solution.

Conditions of the Problem

Lay out an operation sheet to show how and in what order you would machine the surfaces and holes indicated by heavy lines, and design the necessary jigs for drilling and reaming only. The design of the jigs must conform to your sequence of operations. Fractional dimensions have a tolerance of 0.005 inch. The operation sheet must show, in addition to the sequence of operations, your selection of machines, speeds, feeds and floor to floor time.

Material—Nickel steel—S.A.E. 2315, drop forged.

Depth of cut—1/16 to 1/8 inch.

Total quantity—15,000 yearly (in lots of 1,000 each).

Characteristics of Monel Metal

MONEL metal is an alloy having the average composition of nickel 67 per cent, copper 28 per cent and other metals (iron, manganese, silicon) 5 per cent. The principal features of the metal, that render it of commercial value, are resistance to corrosion, the bright nickel finish that it takes and retains, its strength and hardness, particularly at high temperatures, and its resistance to erosion by water and steam. Monel metal is used for many purposes, including pickling tanks and crates, various parts of machinery, small fittings, trimmings, stampings, knives, cooking utensils and similar units. In England, under the trade name of Corronil, an alloy resembling Monel is made.

Casting

The practice used in making sand castings of Monel metal is similar in some respects to steel-foundry practice and in some other respects to that used for iron or brass. The melting practice, also the gates and risers necessary for feeding, are much like those used for steel. The extreme care required in molding and ramming more nearly resembles that for non-ferrous metals. The shrinkage is $\frac{1}{4}$ in. to the foot. Cores must be collapsible to allow free shrinkage of the metal. The pouring temperature required for Monel metal is 2,800 deg. F. It can be melted successfully in graphite crucibles, using oil-fired pit furnaces, in oil-fired clay-brick-lined reverberatory furnaces and in clay-brick-lined or basic-lined electric arc furnaces. All ladles and crucibles used for transferring the metal should be pre-heated to conserve heat in the metal. Cores are made from washed silica sand and raw linseed oil, about 25 to 1 for large cores and 60 to 1 for small work. These should be well vented. Vent wax will be found useful here.

The important parts to watch for are: (1) Use clean metal—not too much scrap; (2) have the composition right; (3) keep the carbon under 0.25 per cent; (4) do not use poor quality fuel, high in sulphur; (5) see that all the metal is deoxidized; (6) have plenty of heat in the metal when pouring; (7) have plenty of metal in sink heads and risers to take care of the shrinkage; (8) give the gases a chance to get away; (9) use chills at heavy sections to produce coincident freezing throughout the casting; (10) give the metal a chance to shrink without being held by the sand.

Forging

Monel metal forging practice follows closely that of steel. It is harder under the hammer than mild steel, approaching more closely the well-known nickel steels in behavior, except that the oxide scale that forms in heating adheres strongly to the metal and refuses to free itself, even under hammer blows with steam and salt. A muffle-type furnace is best adapted, as the metal does not come in direct contact with the flame and allows a more uniform heating. The reverberatory-heating furnace commonly used in forging steel, if properly controlled, is also satisfactory. Billets for forging may be charged directly in a furnace at heat, and brought rapidly to forging temperature. Forging temperatures range from 1,800 to 2,100 deg. F., depending on the class of work. Do not exceed the maximum temperature as the metal becomes hot-short a little beyond this point, and is rendered useless for further work. Heavy work is usually done at the higher range, while light work usually takes the lower temperature. To forge below 1,800 deg. F. endangers the work through hardening and liability of splitting or cracking. Forging hammers and drop hammers are suitable for working monel, but forging presses are not. Drop-forging dies are usually made from 0.80 carbon steel, hardened and tempered to give a hardness of 60 on the sclerescope.

Annealing

Annealing of Monel metal should be accomplished in a reducing atmosphere to prevent any oxidation that might occur if annealed in the open. A reducing anneal will remove any oxide or scale adhering to the metal. The general practice is to place the material to be annealed in a cast-iron box, covered with fine charcoal, put a cast-iron cover on the box and carefully seal it with fireclay. In the case of sheet or strip, the charcoal should be placed between each layer so as to prevent sticking. The box is then placed in the annealing furnace and brought up to temperature. The temperatures for annealing vary somewhat according to the class of material used. Sheets, or articles made of sheets, may best be annealed by heating to temperatures between 1,450 and 1,650 deg. F. The degree of softness obtained is dependent on the temperature. The scleroscope hardness should run from 15 to 18. Rods, wire and similar parts should be annealed at temperatures ranging from 1,450 to 1,700 deg. F. Heating above 1,700 deg. F. does not give any particular advantage. It is also possible to bright-anneal in cyanide.

Soldering and Brazing

Monel metal can be soldered as easily as copper. The same fluxes, solders, tools and methods are used. Care should be taken when sheets or wire are to be soldered to be sure that the last annealing operation has been properly performed under thoroughly reducing conditions. If such was not the case, it is possible to have a material that will not solder because of a thin, invisible film of oxide on the surface of the material. The metal may be silver-soldered, by using a blowpipe or torch with a saturated solution of borax applied to the seam before silver-soldering.

Welding

Monel metal and nickel can be readily welded by the oxy-acetylene, metallic-arc, carbon-arc, spot and resistance welding, and the practice of welding either metal by any of these methods is similar to that followed in welding ordinary low-carbon steel. Thin sheets up to $\frac{1}{8}$ in. should be welded either by carbon-arc or oxy-acetylene flame with flanged edges. Above this the edges should merely be butted, and over $\frac{1}{4}$ in. they should be given a 45-deg. bevel in addition. On long seams and on metal over $\frac{1}{4}$-in. thick, a separation of $\frac{1}{4}$ to $\frac{3}{8}$ in. per ft. may be allowed.

Trim Line

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International Treaty on Arms Traffic Opens Way *for* Munitions Trade

United States favored as future source of supply—Restrictions on legitimate trade are few — Advantages in providing for our own national defense are obvious

By Paul Wooton
Washington Correspondent, *American Machinist*

AFTER the fall of the Krupp plant upon which they depended for their armament supplies, the smaller countries were left in a serious predicament. The new treaty reopens the field of manufacture of arms, and makes available a new source of supply. The small country is no longer a negligible factor from the military standpoint. In these times of coalition, they are the potential weights in the balance. They have realized their situation and those located in troublesome districts appreciate the importance of this treaty for their national defense. The United States is the logical new source of supply.

A GREAT new industry which would employ hundreds of mechanical engineers and technical men, as well as many thousands of machinists and other skilled workmen, is a possibility opened to the United States as an outcome of the new convention on international traffic in arms, in the opinion of Brig. Gen. C. L'H. Ruggles, the assistant chief of Ordnance, U. S. Army, and one of the American delegates to the conference at Geneva. All suspicion and uncertainty which have made trade in munitions a questionable business in the past now have been removed, he points out. This international trade has been defined and legitimatized. The non-manufacturing countries in their procurement programs are to be allowed full and free opportunity to provide themselves with such armament as they may deem necessary to the maintenance of domestic order and as a safeguard against external aggression. In response to questions by the writer, General Ruggles expressed further thoughts, in substance, as follows:

When the Krupps went out of business it limited greatly the sources from which the small, non-producing countries could draw their armament supplies. In their eyes, at least, this is a very serious situation. The smaller countries of Europe are just as anxious to maintain their independence as are larger countries. There is full determination among the new countries to maintain their national entities. They are prepared to be exterminated rather than go back to the old order.

There is a very general desire among them to make their purchases of armament in the United States. They feel that it is important to have the manufacture of their military materiel provided for in a country likely to be neutral in case of European conflict and in a country that could not be intimidated to the extent of applying an embargo on arms exports in case of war. For these reasons, particularly, there is a general desire to have the source of supply in the United States.

On the other hand, the manufacture in this country of the arms requirements of a number of countries would be of inestimable value in providing for our own national defense. Not only would it create going plants for the manufacture of munitions, but more important still, it would allow us to build up a great body of trained men who could be put to work instantly on our own manufacture in case of an emergency.

Armament requirements of the smaller European countries are greater than before the war. There now are more countries. There is great uneasiness, particularly among those countries contiguous to Russia. The other smaller countries of Europe have a new appreciation of their military strength since the war. Any future war is practically certain to be between coalitions of countries. In such an alignment, a well-trained army of even 300,000 men is an important factor. Balance of strength may lie with a small country.

During the World War both the Netherlands and Switzerland served notice on the belligerents that the violation of their neutrality by one would automatically align them with the other side. Germany, it is decleared, was restrained from any infringement on Holland by the knowledge that such action would have added half a million good soldiers to the strength of the Allies.

The treaty provides for a sufficient amount of surveillance to prevent the purchase of arms by insurrectos and outlaw movements, but the restrictions on legitimate trade have been reduced to a minimum.

The treaty is conceded to be one of very great moment to those numerous manufacturers in the United States in a position to undertake some form of armament manufacture. To take full advantage of the opportunity now offered, however, will require the merging of several existing concerns into a powerful unit, since strong financial resources are essential, as payment for the supplies furnished many countries necessarily must be spread over a long period of years.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

Heat-Treating and This Issue

THERE is no necessity to explain in detail to readers of the "American Machinist" the vital importance of heat-treating. They know that it has its influence on the work of every man connected with the machinery industries.

This issue, although emphasizing heat-treatment, in fact because it does, is for all of the divisions of the machinery industries and for every subscriber. It precedes by ten days the convention and exposition of the American Society for Steel Treating and is timed to reach you as your thoughts are attuned to heat-treating.

Hardness Testing in the Laboratory

THE discussion of hardness testing methods printed elsewhere in this issue brings to mind a point in hardness testing that deserves consideration. Existing methods of comparing the hardness of a material with some recognized standard are quite satisfactory for use in production work, and throughout the plant in general. They leave something to be desired, however, in exact laboratory testing.

Why would it not be better, for laboratory tests, to measure the force required to produce an indentation of given dimensions instead of measuring the indentation made by a given force? If the test were conducted in this way the element to be measured would be a straight-line function, force in pounds, and any calculations that had to be made would be correspondingly simplified.

It would be interesting to get the views of laboratory men and of the makers of instruments, on the soundness of the principle involved and the practicability of applying it in the laboratory.

Limit, Unlimited

"DIMENSIONS shown in decimals, unless otherwise marked, are to be held to a limit of 0.005 in." That statement is supposed ordinarily to mean that the machinist is permitted as much as 0.005 in. below or 0.005 in. above the decimal dimensions given.

So long as everybody concerned knows what it means, well and good. But if the buyer happens to mean that he wants a tolerance of 0.005 in. ($\pm$0.0025) and the seller thinks he means a limit of 0.005 either way, observe the fireworks.

The terms limit and tolerance are handled loosely. Why not say on a drawing, "Dimensions shown in decimals, unless otherwise marked, are to be held to limits of $\pm$0.005 in."?

In talking, if a man is asked what limit he has on a dimension, he will probably say, "We hold that to a thousandth," and upon further questioning, is likely to show that he doesn't really know whether the limits are $\pm$0.001 in. or $\pm$0.0005 in. It is even possible that he will not know what tolerance means.

Loose talking and looser thinking about limits and tolerances afford endless opportunities for altercations between buyer and seller, production department and inspection department, shop man and engineer. The remedy seems simple, yet we don't take it. Let's reform.

Keep Track of Small Tools

A MANUFACTURER of electric drills writes us that during the year 1924 twenty-one electric drills were reported stolen from his customers. Not such a quantity as to be alarming when compared to the total in use, but more than there is any necessity for.

It is easy to prevent theft of electric and pneumatic drills and similar small tools of value. They should be issued from the tool room on check and returned each evening. The daily round-up should be accompanied by inspection. If it is, not only will the tool be retained by the owner but it will stay with him longer, because of the extension of life that will result from regular inspection and accompanying maintenance.

Just Suppose

JUST suppose that your competitor comes out with a product better than yours and begins to cut into what you consider is your share of the market. You are much stronger financially than he is and you decide to go after his skin by putting the price of your inferior product down to cost or below, knowing that you can afford to lose a lot more money than he can. Nice, ethical procedure, isn't it?

But, you say, some of our biggest fortunes have been made that way. Well, perhaps a few have, but leaving out the ethics of the thing, how many men and companies have gone broke trying to kill competition in a price war? And how has public opinion regarded even the successful ones?

And now suppose that instead of spending your good money in a price war you had put it into good engineering, into better designing, into research that would make your product compete with the other fellow's. Not only would you have a better product but your conscience would be clear; you would have added something to the general store of knowledge and you would have built up your good will account. Wouldn't it be fine if all machinery builders believed in the soundness of this way of meeting competition?

Just suppose.

Shop Equipment News

Cincinnati High-Power and M-Type Pyramid-Column Milling Machines

Changes in design on its lines of milling machines to result in an increase of delivered power at the cutter for a given input; rigid and compact construction to maintain accuracy in service; convenient, safeguarded control for modern production performance; assured lubrication and accessibility for adjustment and maintenance; are announced by the Cincinnati Milling Machine Co., Cincinnati, Ohio.

The improvements affect the Nos. 2 and 3 high-power machines of the plain and universal types, the No. 3 high-power vertical; the No. 3 standard in the plain and universal designs and the Nos. 1M and 2M, plain, universal and vertical.

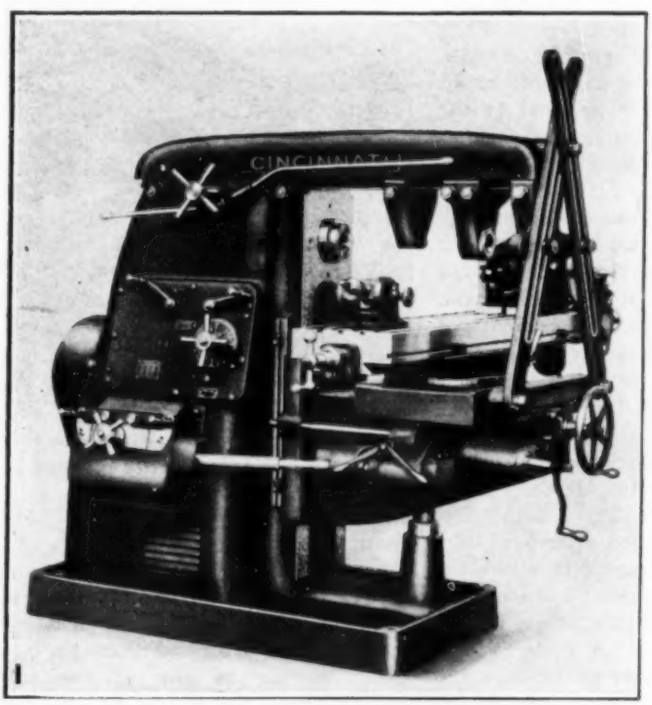
Friction and transmission losses have been considerably reduced by including Timken adjustable roller bearings in the main drive and by the use of a sliding-gear transmission. The combined gain is said on test to be approximately 15 per cent in the power delivered to the spindle.

Rigidity has resulted from a number of points of design. The column has been gradually widened from the overarm bearing down to the base and is termed its pyramid construction by the company. The base is heavily ribbed. The heavy rectangular overarm of box-type construction is scraped to accurate bearing on the column. A number of points of design of the combined knee, saddle and table also add to the claim for rigidity.

Compactness is evidenced in the motor location in the column with its chain drive to the spindle through the sliding-gear assembly also inclosed in the column, in the design of the optional belt drive, in the construction of the transmission itself, in the grouping of the control levers and in the location of the coolant reservoir within the base protected by screens from chips.

The control handles and levers are mounted and grouped for convenience as well as compactness, and can be operated from either side of the table. On the larger high-power machines, as illustrated in Fig. 1, the feed-gear assembly and control is on the side of the column while the feed-engaging lever and the clutch lever are each extended in two directions. On the M type, illustrated in Fig. 2, the feed assembly is mounted on the front of the knee which, with the arrangement of clutch and speed control, enables the operator to set speeds, feeds, direction of spindle rotation and to start or stop the machine, all from his working position at the front. A safety-feed device releases the feed when sudden overloads are imposed on the M-type millers.

There is one other essential point of difference between the high-power millers and the M types in that the former, of plain and vertical construction, are equipped regularly with an arrangement for rapid power traverse while the M-type millers are not. This movement is controlled by a hand lever at the



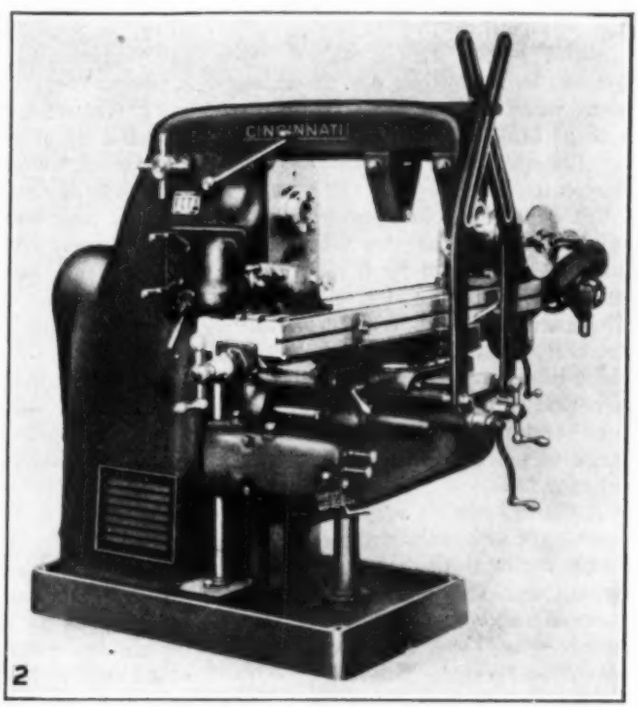


Fig. 1—Cincinnati High-Power Pyramid-Column Milling Machine. Fig. 2—The M-type pyramid-column machine

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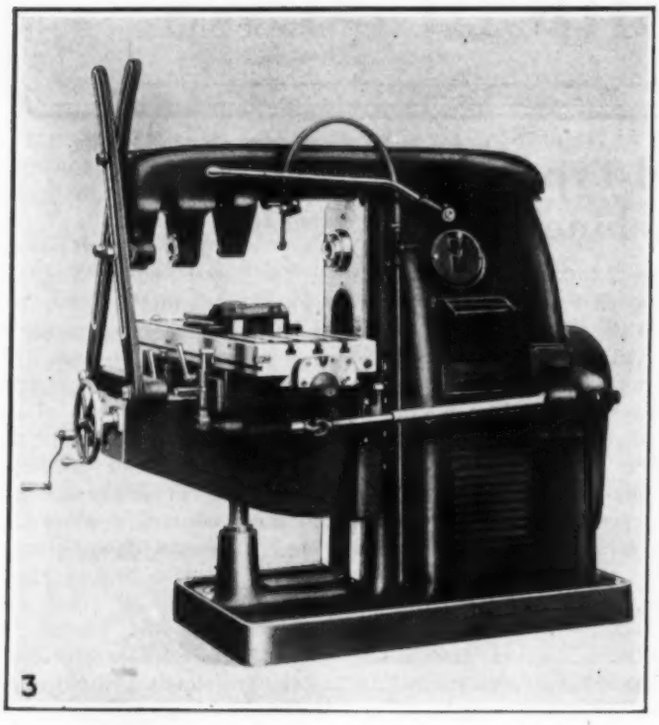

Fig. 3—The right-hand side of the high-power design.

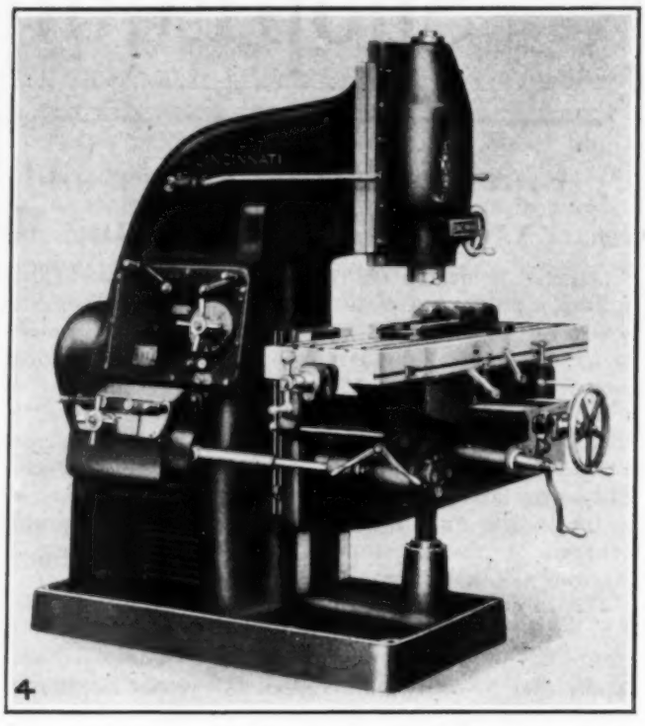

Fig. 4—The vertical high-power, pyramid-column miller

right side of the table. To be operative, the lever must be held in position and all motion ceases as soon as it is released. The drive for the movement is located as shown in Fig. 3 on the right-hand side of the machine. Here also may be seen the duplicate clutch lever which is furnished on all of the six styles.

Hand levers are arranged with springs to hold them out of engagement when they are not being used and a brake stops further spindle rotation instantly upon throwing out the clutch lever.

All of the mechanism within the column as well as the feed box is automatically oiled by a pump while the multiple disc clutch runs in oil. The knee, saddle and table are oiled from five stations which hold sufficient lubricant in reserve to last for a period of time. The supply openings are protected and sufficiently large to permit using a large-mouth oil can.

All parts which may require adjustments are readily accessible such as the motor in the column, the chain drive, and the shafts on Timken tapered roller bearings in the transmission and the main spindle and arbor bearings.

In Fig. 4 is illustrated the vertical design of the high-power line. All points of design are similar to the horizontal high-power machines with the exception of the vertical head, and the column design to accommodate it.

The vertical head is moveable in ways on the column and carries the spindle in fixed bearings. It can be moved rapidly by hand, using a pilot wheel or slowly by means of a worm and wormwheel as regular design. A power feed is also available as an extra feature and is adapted to the machine by attaching a feed box in place of the worm-box on the right-hand side of the head. Four changes in feed are then available through sliding gears reading in thousandths of an inch per revolution of the spindle, rather than in inches per minute, for the direct convenience of the operator. The power feed can be engaged in either direction by a lever at the front which indicates the direction of movement by its position.

The machines can be supplied with either belt or motor drive. When the former is specified a detachable plate, and box-shaped guards protect the belt for a distance 6 ft. above the floor. When the motor is desired, it is mounted as illustrated in Fig. 5 within the column. A plate is provided that is secured to the base and to which the motor is bolted. There are no hinges nor a chain-takeup arrangement except for shims under the plate since the company desired this setting to be rigid. The chain is stretched before installation to minimize increasing looseness when the miller is put into service. Ventilation is taken care of by arranging louvres in the removable plates

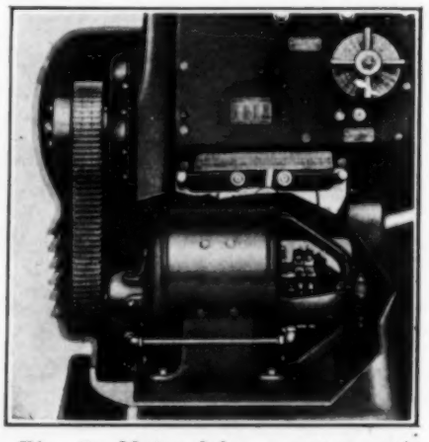

Fig. 5—Motor-drive arrangement and chain drive in the column

on each side of the column and in the chain guard cover at the rear. By taking this rear cover off, access can be had to the motor for removing or aligning it. The reservoir bearings in the motor are oiled through pipe lines leading to one of the side louvre covers as shown in the sectional illustration. Motor sizes of 3, 5, 7½ and 10 hp. are recommended

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to drive the 1M, 2M, 2 high-power and 3 high-power machines respectively. On all, the speed of the driven shaft carrying the clutch should be 600 revolutions per minute.

The construction and arrangement of the transmission is shown in Fig. 6, a line drawing which applies to the M-type machines but which is essentially the same for the high power sizes.

The driving pulley or sprocket, the clutch and the brake are mounted in the drive-shaft assembly and are carried as a unit in a bracket bolted to the rear of the column. The entire assembly is supported on roller bearings in the bracket. The clutch design includes the spring shown which serves to compensate for all wear and attendant end play. This makes any manual adjustment unnecessary during the life of the machine. The clutch which is of the multiple-disc type is actuated from a sliding member mounted to the right. This member actuates roller-mounted cams to engage and disengage the drive.

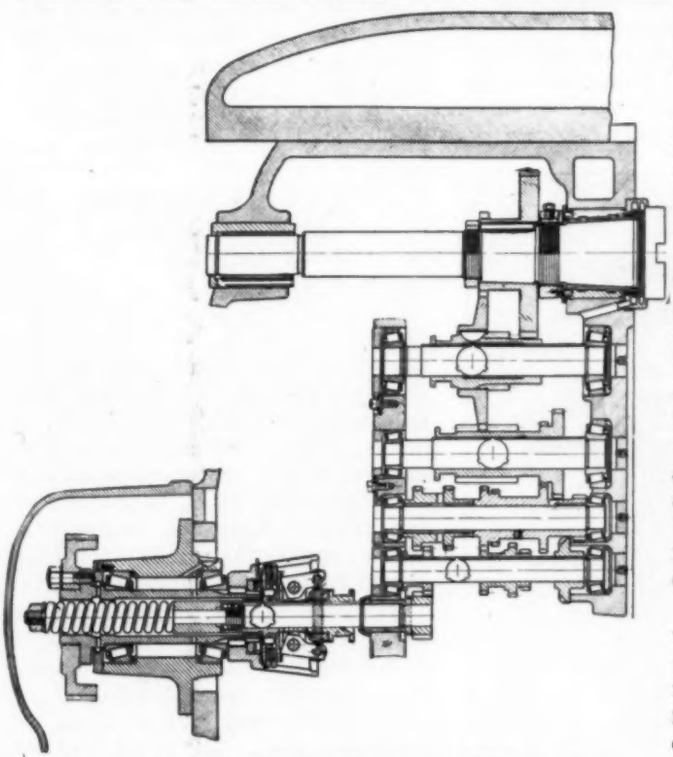

Fig. 6—Layout of roller-bearing, sliding-gear transmission in the M-type machines

The right-hand face of the engaging member is machined with a taper that matches a stationary cone in which the right-hand end of the shaft rotates. When the clutch lever is thrown beyond its out position the cone and taper come in contact to act as a brake against further movement.

The sliding-gear train is shown above the clutch shaft, each shaft mounted on adjustable roller bearings and splined to drive the gears. The final drive is to a selective pair of gears keyed and mounted on the main spindle. The illustration shows the construction of the spindle bearings and the spindle thrust and adjusting collars.

Just under the main tapered bearing on the 2 and 3 high-power machines is a passage through which the lubricating oil is pumped. This passage ends in a spray nozzle that directs the oil in all directions over the gears and the transmission bearings. The gears are of alloy steel and are heat-treated.

The spindle which is also made of heat-treated alloy steel is fitted on all of the single-pulley machines with the standard Cincinnati flanged end and with a No. 14 B.&S. taper hole, making face mills, arbors, shell end-mills, and similar tools interchangeable for all the machine sizes.

On the M-type there are 12 speeds ranging from 20 to 419 r.p.m. in either direction which is increased on the high power machines to 16 speeds between 18 and 500 r.p.m. The speeds are set by means of levers and a wheel mounted on a plate on the side of the column. Under the wheel is a direct-reading index.

The feed-change gears are also controlled by levers with a direct-reading plate. On the M-type 12 changes are provided from ½ to 20 inches per minute, and on the high-power design 16 changes in the same total range. The feed-engaging levers are set to point in the direction of travel when they are engaged, an important factor in operation. This is also true of the power rapid traverse which moves the tables on the high-power machines at 100 ft. per minute.

To assist in rapid and careful set-up a handwheel which engages with a gear and rack on the over-arm can be used to easily move and accurately position the arm in its ways.

The long knee bearing on the column is arranged with an adjustable tapered gib maintaining a full, rigid bearing between knee and column, no clamping of the knee being necessary. The saddle is long and the table bearing is as wide as the table to eliminate overhang. Bearing surfaces of the knee, saddle, table and column are chilled.

On the high-power machines the cutter-lubricant pump is standard equipment as well as an all-steel vise. On the M-type millers the pump is furnished as an extra. A circular-milling attachment and other conventional attachments are also available as extras.

DuPont Engineering Co. "Everdur" No.-50

The DuPont Engineering Co., Wilmington, Del., is manufacturing for the market a non-corrosive metal, known as "Everdur" No.-50, in the form of rods, sheets, castings, tubes and other customary shapes.

The metal is a type of bronze being composed of 94.5 per cent of copper, 4.5 per cent of silicon and 1.0 per cent of manganese. Its principal advantages are claimed to be in its resistance to the action of corroding liquids and gases and the fact that it can be machined easily, as well as welded, soldered or brazed in the same manner as copper or the standard bronzes.

It can be cast, rolled, flanged, forged, spun or drawn to any form in which copper can be obtained on the market.

Exhaustive tests have been made under a wide range of conditions so the company is in position to recommend and limit its uses to the best advantage of any prospective user upon being advised of the true operating problem which is to be met.

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Heald Automatic Internal Grinding Machine

The Heald Machine Co., Worcester, Mass. has recently completed, and now has ready for the market, the logical development of its line of hydraulically-operated, hole-grinding machinery in the shape of a machine of this type in which the movements are fully automatic from the moment the operator places the work-piece in the chuck until the grinding is completed accurately to gage size.

The sequence of the automatic movements, in the order in which they occur, is as follows: The table runs in at full speed, approximately 50 ft. per min., until it reaches the grinding position, when it slows to a previously determined rate of traverse for rough grinding and continues to reciprocate at that speed within the limits set by the depth of the hole. At the same time the wheel is fed to the work by increments that are also previously determined as suitable for the nature of the material to be ground.

When the diameter of the bore has reached a size that is two, three or more thousandths of an inch below the nominal gage size—a "finish allowance" that is variable at will—the amplitude of table stroke increases sufficiently to allow the wheel to withdraw from the work and pass, at a slow rate of traverse, over a truing diamond that has been dropped into place for the purpose.

The wheel passes twice over the stationary diamond, truing and dressing itself in the passage. It then returns to the work and continues to reciprocate within the previous limits at a rate of traverse considerably faster than while being trued, but not nearly so fast as it had been moving during the rough-grinding operation. At the same time the increment of feed is reduced to an arbitrary limit of 0.0002 in. per stroke of the table.

This finish grinding continues until the bore is brought gage size, when the cycle is completed by the passing of the table and wheelhead to its extreme right-hand position, where it comes to rest. At the same moment the size-control device is swung away from the work-piece, the rotary movement of the work-spindle stops, the supply of coolant is shut off and the machine is ready for unloading and reloading.

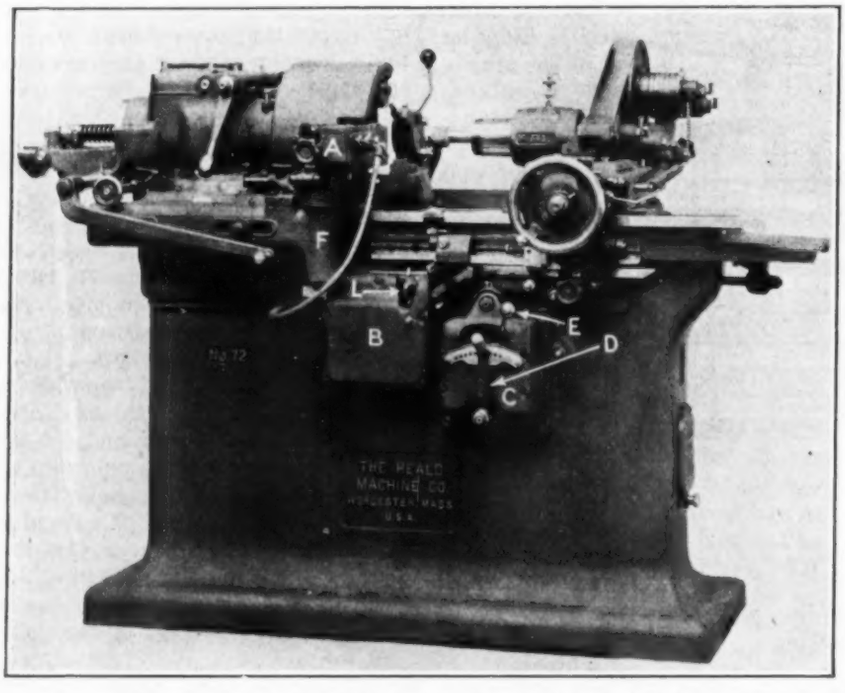

Fig. 1—Heald Automatic Internal Grinding Machine

Though it would appear, at first glance, that a machine capable of performing, without assistance from an operator, a series of operations so involved would of necessity be itself somewhat complicated, such is not really the case. The mechanisms to bring about these results are comparatively few in number, simple in design and construction, and positive in their action.

In its fundamental principles the machine is the standard internal grinding machine with hydraulically-operated table which is regularly built by the Heald Co. and was previously described on page 33, Vol. 63 of the *American Machinist*. To this machine has been added the automatic features, some of which derive their motions mechanically from the moving table, others from the pressure of the oil that is already the actuating medium of the table, and still others—notably the sizing devices—from magnetism induced by an electric current that is supplied by a small electric generator attached to and driven by the machine.

In Fig. 1 may be seen a front view of the machine, from which it will be observed that about the only apparent additions to the original machine are the size-indicating device *A*, which is, so-to-speak, the pilot that keeps watch upon the increasing diameter of the hole and transmits the impulses necessary to bring about certain mechanical changes at the proper moment, and the magnet-box at *B*, to the left of the regular hydraulic control-box, which supplies the physical force required to make the changes operative.

The lower member of the workhead is in the form of a bridge that is bolted rigidly to the base of the machine, leaving space beneath it so that the forward extension of the table may pass. The upper member is made to swivel upon the lower one so that the centerline of the work spindle may be deflected horizontally in either direction. This adjustment is primarily for the purpose of securing accurate alignment to grind parallel holes, but it may also be used, without the automatic sizing feature, to grind tapered holes.

The work-spindle runs in self-adjusting radial ball bearings which are so designed that they will need

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no attention other than oiling during the life of the machine. The construction of the spindle is such that either push- or pull-collets may be used, or standard chucks may be screwed on the spindle nose.

A splash guard, made of aluminum, is mounted on a spring hinge over the chuck so that it may be thrown back out of the way without the necessity for withdrawing bolts or loosening latches. A 1¼-in. through hole in the spindle is the channel throught which a cooling medium is delivered upon the work and wheel. The long, horizontal lever to the left is not a part of the machine but of the work-holding units, its purpose being to manipulate the collets. The pendant lever in front of the workhead operates a clutch to stop and start the rotative movement of the spindle at the will of the operator, but in this machine it is merely an auxiliary, as these movements are ordinarily performed automatically.

The wheelhead is of the standard design used by the company on all of its later internal grinding machines. It is mounted on a cross-slide that is gibbed to the traversing table and carries, beside the wheel-spindle, the intermediate countershaft and the spring-suspended idler to maintain a proper tension upon the small belt that drives the wheel. The wheel-spindle, pulley, ball bearings and the containing tube comprise a complete independent unit that, by loosening a clamping bolt, may be slipped out of the head and others of different size or length substituted.

The cross-slide is actuated by a screw of large diameter and coarse pitch which derives its movement from a loosely-mounted ratchet and handwheel through a train of speed-reducing gears located within the shell upon which the ratchet teeth are cut. The ratio of reduction of the train is such that one full turn of the wheel displaces the slide but 0.030 in., causing an increase of 0.060 in. in the diameter of a ground bore. The dial is therefore graduated to 60 divisions, indicating thousandths of diameter, approximately ⅜ in. apart. The ratchet has 300 teeth, each tooth corresponding to an increase of 0.0002 in. in the size of the bore being ground. Fig. 2 shows the feeding mechanism with the handwheel removed from the cross-screw.

The traversing table, which carries the wheelhead, is moved by a hydraulic cylinder and piston, deriving its power from a column of oil under pressure from a geared pump attached to and driven by the machine. The movement of the oil through the cylinder is controlled and directed by a master throttle and a reversing value contained within the control-box *C*, Fig. 1, on the front of the machine; by a supplementary throttle on the back of the machine; and by a by-pass valve, controlled by cams on the table itself, that, when open, permits the oil to flow at the full speed due to its pressure and corresponds to a table speed of approximately 50 ft. per minute.

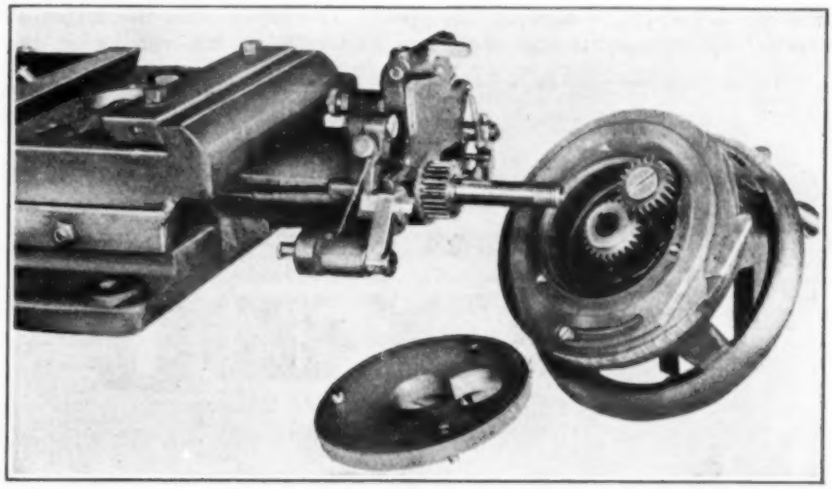

Fig. 2—The cross-feed actuating mechanism

With the lever *D* of the master throttle in its extreme right-hand position no oil can pass the valve and no movement of the table will take place. When the lever is in the extreme left-hand position the valve is wide open and the movement of the table, the supplementary throttle permitting, will be at full speed. Thus, any rate of table traverse from zero to 50 ft. per minute is instantly available by merely shifting the position of the lever.

The ball-tipped lever *E* controls the reversing valve, and the motion of the table will be in the direction corresponding to the inclination of this lever. When it is in mid-position no movement of the table can take place, but the lever will not stay in mid-position unless purposely held there by the operator.

When the lever *D* is set for the desired rate of table traverse it is not again moved during the progress of the job in hand. The slower rates of traverse for truing the wheel and for finish-grinding the hole are brought about automatically by means of the supplementary throttle already mentioned. This is merely a second valve introduced in the oil-pressure line ahead of the main throttle, and can be set to allow any table speed below that for which the main throttle is adjusted.

The run-out of the table after a hole has been ground to size, and the run-in at the start of the cycle, are always at full speed, the movement being brought about by the momentary opening of the by-pass valve which delivers oil at full pressure to the piston regardless of the position of either throttle.

The diamond wheel-truing device may best be observed in Fig. 3 which shows also the workhead and chuck together with the levers and connections through which the spindle is automatically stopped and started. The diamond is thrown down into position to dress the wheel by hydraulic pressure and, when the truing operation is completed, it is lifted out of the way of the advancing wheelhead mechanically by means of a cam on the table.

In the same illustration may be seen the size-controlling device, which not only keeps the operator informed of the increasing diameter of the bore being ground, but, of its own volition, interrupts the process when the final size has been reached. The

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case in which the mechanism is contained is mounted to swivel about a vertical axis at *F*, and is held normally in the position there shown by the large torsion spring that can be seen coiled about the supporting bracket.

When the wheelhead is run back for the purpose of changing workpieces in the chuck, a cam on the traverse table swings the case of the sizing device around to a position nearly at right-angles, in which position it is entirely clear of the work.

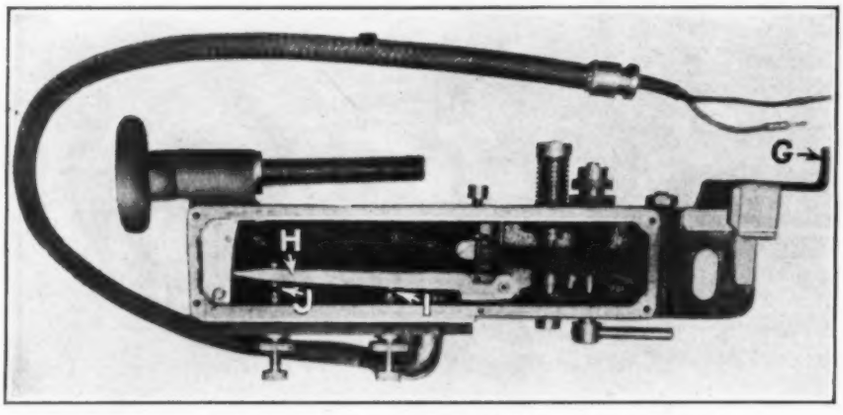

Fig. 4—Interior of sizing device with cover removed

A view of the sizing device is shown separately in Fig. 4, in which the cover of the case has been removed to display the mechanism. When in place on the machine, the diamond-tipped finger *G* extends a short way into the hole being ground, where it rests under tension of a spring against the wall of the hole on the side nearest the operator. The grinding wheel in this, as in all of the later Heald machines, cuts on the rear wall of the hole.

The finger *G* is connected through a series of amplifying levers to the indicating pointer *H*, which is caused to move over a graduated scale, as the finger is drawn back by its spring, in accordance with the increasing diameter of the hole being ground. In operation the top of the case, shown open in this view, is closed by a tightly-fitting cover with a glazed window at the end so that the working parts are protected without obstructing the operator's view of the scale.

At *I* and *J* in this illustration may be seen two pairs of electric contact points placed so that as the pointer *H* swings toward the zero of the scale—indicating finish diameter of the hole—a circuit is closed, first through the inner and then through the outer pair of points.

The inner-point *I* is mounted upon a light spring so that as the pointer continues to move, this point remains closed but does not interfere with the further movement of the pointer necessary to close the second pair. The effect upon the action of the machine by the closing of the respective circuits will be described in connection with the machine cycle.

Though the sizing device is the monitor that says when certain changes shall take place in the orderly sequence of movements throughout the machine cycle, it is the magnet-box, shown open in Fig. 5, that is called upon to execute them.

This box contains a connector-block *K;* a single-pole, two-throw switch *L*, the two-pronged lever of which is outside the cover when the box is closed; a small piston-valve *M* in the oil line; two electro-magnets, one of which is visible at *N;* and two finger-levers, *O* and *P*, projecting outside the box and carrying upon their inner ends the armatures of the respective magnets. An intermediate projection upon lever *P* is coupled to the plunger of the oil valve.

The supplementary throttle is a semi-rotary valve attached to the back of the machine at *Q*, Fig. 6, and through it passes all of the oil that later must pass through the main throttle and reversing valve on its way to the table-actuating cylinder.

Two movements of the table, however, do not depend upon this or the main valve. These movements are the run-out and the run-in at the end and beginning of the cycle respectively.

Though the movement of the supplementary throttle is instigated by the magnet-box, it is not brought about directly by it. When the piston valve *M* is opened by the magnet to throw down the wheel-truing diamond, it causes a partial rotation of a rocker-shaft on the back of the machine from which depends the arm *R*, Fig. 6, terminating in a rectangular yoke, in each end of which is an adjustable stop-screw.

Though the arm moves through its full amplitude with each movement of the diamond, the setting of these stop-screws determines the amount of opening that is given by it to the supplementary throttle.

There are thus two possible (and variable) positions of the valve during the cycle, both of which determine a rate of traverse given to the table and wheelhead. This is, however, within certain limits. The supplementary throttle may be set to slow the table movement to any reasonable degree, but never entirely to stop it. Also the wider opening may be set to induce any faster rate of traverse below that for which the main throttle is already set. It cannot, even though wide open, get any more oil to the cylinder than will pass the main valve.

In following the sequence of movements let us start with the table run out to its extreme right position where all of the working parts are at rest. A switch-valve in the oil-pressure line has been thrown by the last remaining inch of table-travel and the oil is merely circulating through the system without doing any work. The work-spindle is idle, though the clutch pulley is running, and the supply of coolant is shut off.

The rear shaft, to which are connected the oil-pump, the coolant-pump and the electric generator, continues to run, as also does the grinding wheel, so that energy to put any of the mechanisms into instant operation is always available. The by-pass valve, through which was delivered the oil that caused the table to run out at high speed, remains wide open. The ball-tipped lever of the reversing valve leans to the right, in the direction of the last movement of the table. The case of the sizing device is swung out,

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away from the chuck, so that the latter is clear of obstruction and ready to be loaded. The supplementary throttle is wide open and the main throttle remains in its predetermined position to secure a proper rate of table traverse for rough grinding.

The operator places a piece of work in the collet and secures it by a slight movement of the collet-actuating lever at his left. He then tips the reversing lever to the left, thus bringing the automatic mechanism into action by admitting oil behind the piston and causing the table to move forward. That is all that he has to do with it until the grinding is completed.

The table moves forward at full speed until the grinding wheel is about to enter the hole in the work, when it slows to its predetermined rate of traverse (predetermined by the setting of the main throttle) for rough grinding, because of the closing of the by-pass valve by cams upon the table itself. At the same instant the clutch of the work-spindle is engaged and the supply of coolant is turned on. Some of the cams that bring about these several movements may be seen at *S* in Fig. 6. They are all adjustable along the table to become operative at whatever point of the stroke may be desired.

Released from its angular position by the advance of the table, the sizing device swings around until the diamond-tipped finger enters the bore of the work and the case comes to rest against a stop with the diamond bearing upon the wall of the hole, thus lifting the pointer from the zero of the scale by an amount equal to the grinding allowance in the hole.

The table now reciprocates between the limits established by the setting of the reversing dogs, *T*, Fig. 5, a distance sufficient to carry the grinding wheel just through the hole in each direction. The rate of traverse is already established by the previous setting of the main throttle. At the same time the ratchet cross-feed, mechanically operated by a fixed cam on the machine bed, comes into action to feed the wheel into the work at whatever increment per stroke is established by the previous setting of the pawl. This is determined by the nature of the work and the amount of stock to be removed.

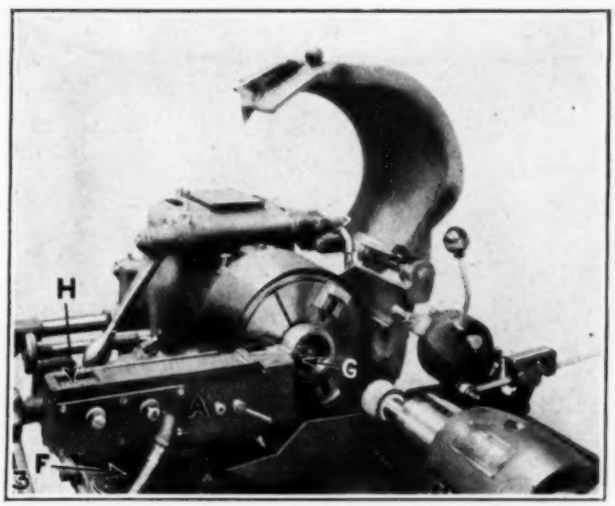
As the stock is ground out of the hole, the pointer of the sizing device settles back toward the zero of the scale, but, just before reaching it and while there are still one or two thousandths of stock remaining before finish size is reached, the contact points *I*, Fig. 4, come together and send an electric impulse through the magnet. The pull of magnet *N*, Fig. 5, causes the long end of lever *P* to rise into the path of the moving table dogs, where it contacts with and raises the latch lever *U* as the table moves outward.

The main table-reversing dogs *T* and *T-1* are clamped to the front face of the table when setting up the machine, to give the desired length of stroke. Upon the dog *T* devolves, at all times, the duty of reversing the direction of traverse when the grinding wheel reaches the bottom, or inner end, of the hole to be ground, but dog *T-1* is merely a backstop for the loose dog *T-2*, which does the reversing at the opposite end of the stroke.

At the moment when lever *P* is lifted by the magnet, dog *T-2* is some distance to the right of the position occupied by it in Fig. 5, and is at the outer end of latch *U*, by which it is held during the rough grinding. With the latch lifted, the dog *T-2*, upon coming in contact with the end of the mechanical reversing lever *V* as the table moves outward, (lever *V* is connected to the hand reversing lever *E* and moves with it, but in the opposite direction) is pushed along by it until the knurled-head stop-screw *W* contacts with the main dog *T-1* and it can move no farther.

The recession of the active reversing dog *T-2* allows the table stroke to be increased by about 2 in., providing a sufficient amount of extra travel to withdraw the wheel from the work and pass it by the diamond.

When magnet *N* moved lever *P*, the latter, by its downward extension, opened valve *M* and admitted oil to a small cylinder on the diamond truing device, causing the diamond to be lowered into line with the rear wall of the hole being ground. In this position the revolving wheel passes twice over it as the table makes one movement to and from the new rearward limit.



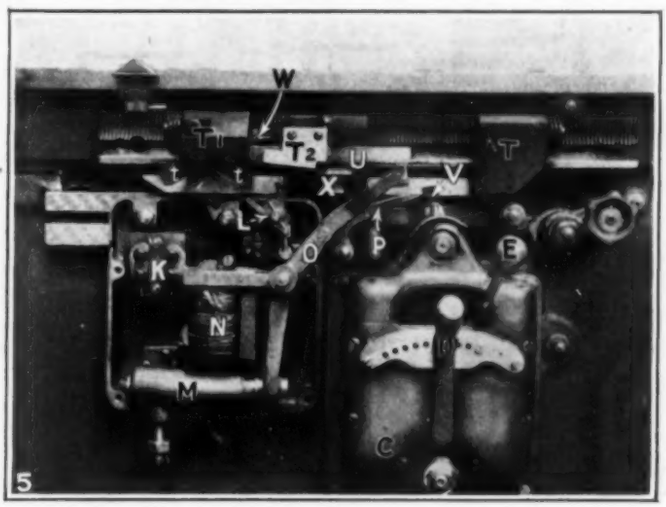


Fig. 3—Detail showing diamond truing and automatic sizing devices. Fig. 5—Detail of magnet-box and table control

SHOP EQUIPMENT NEWS

Referring now to Fig. 6, the hydraulically-operated movement of lowering the diamond to dressing position, caused indirectly by the energizing of the magnet, also caused the arm *R* to swing inward, partially closing the supplementary throttle, which until this moment had remained open. A part of the arm movement is lost motion, owing to the distance between the ends of the opposed stop-screws in the yoke at its lower end but these screws are sidewise, as are also the two prongs of the switch lever *L* with which they contact, so that each acts only in one direction. During the rough grinding the dog *T-2* remains at the end of the latch *U* and the latches *t-t* do not reach the switch lever.

When, however, the table moves to the right at its amplified range, one of the latches *t* passes and tips over lever *L*, breaking the electric circuit through magnet *N* but at the same time closing the switch through its

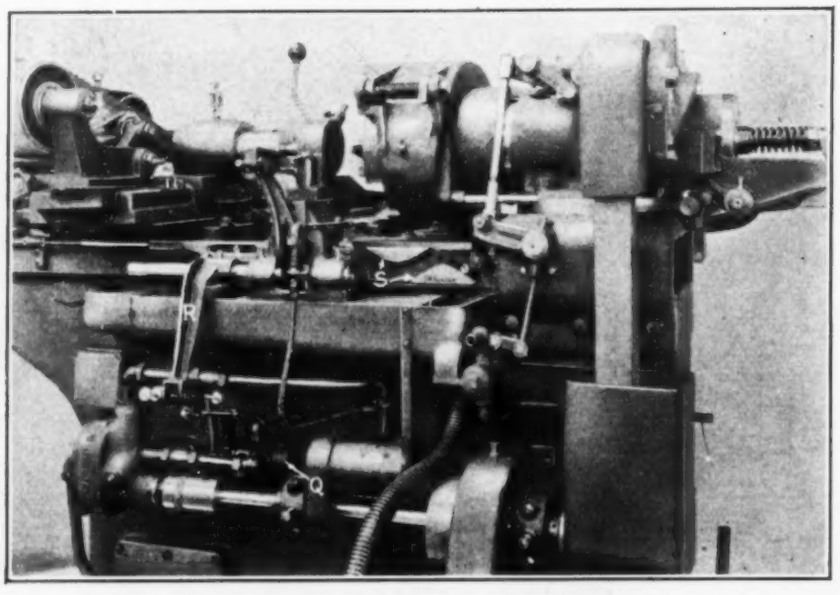


Fig. 6—Rear view, showing pump, electric generator and supplementary throttle control

so set as to adjust the valve to a position that results in the desired reduction of speed at the table.

The partial closing of the supplementary throttle chokes off a part of the oil supply, so that simultaneously with the increased amplitude of the table movement its speed is reduced very materially and the wheel passes slowly back and forth over the diamond.

As the contact points *I*, Fig. 4, cannot re-open, and as the table would continue to reciprocate indefinitely at the increased amplitude and reduced speed unless the magnet were de-energized, some other means must be provided to bring about this condition. This is the reason for the two-throw switch *L* in the magnet-box.

Depending from the main dog *T-1* in Fig. 5 may be seen two gravity latches *t-t*, pointing in opposite directions. Though these latches appear to be in line, they are actually offset other pole, which is in another circuit passing through the hidden magnet behind *N* and through the contacts *J* of the sizing device which are still open.

De-energizing magnet *N* causes lever *P* to drop, closing valve *M* and allowing dog *T-2* to be latched in its original position as it is returned there by the movement of the table. The table now returns to its former range of movement, pushing back the wheel-truing diamond as it advances. The movement of the diamond causes the lever *R* to swing outward and open the supplementary throttle. This opening is, however, but a partial one, the valve still choking the oil supply so that the table reciprocates at a speed much slower than when it was rough grinding, but, still, considerably faster than when truing the wheel.

Coincident with the second change in the table movements, but caused by entirely independent means, a change is brought about mechanically in the cross-feed, reducing it from the rate at which it was set for rough grinding to an arbitrary increment of 0.0001 in. of advance to each double stroke of the table. The diameter of the bore being ground is thus increased by 0.0002-in. at each double pass of the newly-trued and dressed wheel.

The finish grinding continues until the pointer *H*, Fig. 4, reaches zero on its scale, indicating finish size of the hole, at which time points *J* establish the second electrical contact and send a current through the other magnet, causing it to lift lever *O* into the path of the table dogs. The gravity latch *X*, which is the actual point of contact between dog *T-2* and the reversing lever *V*, is lifted by lever *O* to ride over the latter, and there is nothing now remaining to again reverse the table movement. Consequently the table runs out to the right, throwing open the by-pass valve as it goes by its former limit, and passes at full speed to its extreme right-hand position. The final movement of the table also throws the supplementary throttle wide open, and all parts come to rest in the positions occupied at the start, ready to repeat the cycle.

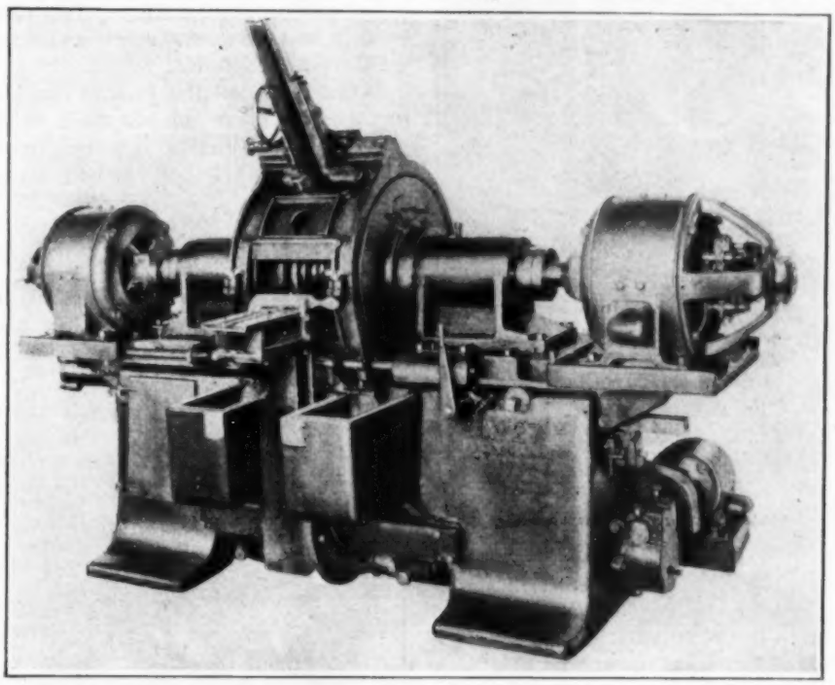
Though this somewhat complex series of movements requires a deal of explaining, its actual accomplishment is a matter of seconds. The makers of the machine claim that bores can be duplicated indefinitely to a limit of error of 0.0005-in. and, with a little extra care, to a limit of 0.0002-inch. The wear and redressing of the wheel is compensated automatically, and to secure these results the operator needs only to make an occasional adjustment of a micrometer-graduated screw in the sizing device.

The workhead swings work up to 15 in. in diameter, and holes may be ground up to 6 in. in diameter by 6 in. deep. Five rotative speeds are provided for the work-spindle. The machine occupies a floor space of 49½x90 in., and weighs approximately 5,500 pounds. It is designed to be driven by any one of three styles of drive, from a specially constructed countershaft; with the workhead driven by a belt from the rear shaft; or with one motor on the wheelhead, another on the workhead, and a third on the rear shaft.

SHOP EQUIPMENT NEWS

Gardner Oilgear-Feed Double-Spindle Disk Grinder

The Gardner Machine Co., 410 East Gardner St., Beloit, Wis., has added to its line of grinding machines a double-spindle disk grinder, suitable for handling a variety of large work. The machine is similar to the No. 27 model described on page 483, Vol. 60, of the *American Machinist*, but is adapted to considerably larger parts that have opposite flat surfaces of approximately equal area. The machine will take work from 0 to 12 in. in length, whereas the standard No. 27 handles only parts from $\frac{3}{4}$ to $8\frac{1}{4}$ in. long. The machine carries 20-in. diameter steel-disk wheels interchangeable with 18-in. shallow-type Perfection ring-wheel chucks.



Gardner Oilgear-Feed Double-Spindle Disk Grinder

The base is built proportionately heavier, so that it will stand up under more severe requirements. In order to obtain longer travel of grinding heads, a longer oil cylinder is used, the operation being the same as in the standard machine. An idea of the sturdy construction of this tool and the large work that it can handle may be gained from the fact that in the motor-driven type it is regularly equipped with two 10-hp. motors.

The ways in the sub-base that carry the grinding head have been lengthened to 25 in. This size is 9 in. longer than on the standard machine permitting a greater opening between the grinding members. Both heads are provided with an individual adjustment to compensate for any uneven wear of grinding members that might take place.

The hood inclosing the grinding members is of the telescoping type, permitting the maximum opening between the grinding members to be obtained with a minimum overhang. The upper half of the hood is hinged to permit easy accessibility.

The end sections of the hood are carried on the spindle-bearing housings, which, being integral parts of the grinding heads, afford ample support to the sections. The hood is machined inside to fit the end sections, which in turn are machined to insure alignment. A wide felt retaining ring, fitting in a groove extending around the circumference of the end sections, acts as a sealing ring in case of wet grinding and as a dust retainer when the grinding is handled dry.

The dressing device is similar to that used in the standard machine. On the top of the heavy hood is mounted a horizontal slide with screw adjustment that carries the wheel-truing device. It consists of a Ross dresser mounted in a gibbed vertical slide, operated by a handwheel through a rack and pinion. The dresser is always in position ready for immediate use, yet in no way interferes with the set-up or operation of the machine. It is unnecessary to stop the grinding wheels to bring it into action. Both grinding wheels are trued with the one dresser, assisting in obtaining exact parallelism.

Nichrome-Bearing Cast Iron

The Driver-Harris Co., Harrison, N. J., has worked out a process of adding nickel and chromium to cast iron in controllable amounts prior to pouring. It has been known for some time that the addition is of benefit to the resulting castings, and the company has applied for patents on a process that is claimed to exert control on the proportions of the mix.

In Figs. 1 and 2 are shown microphotographs of castings that have been magnified 200 diameters. In the first is shown a piece of plain cast iron, while in the second is a sample from the same ladle to which 2 per cent of nichrome has been added.

Bars of nichrome containing 60 points of nickel and 12 of chromium

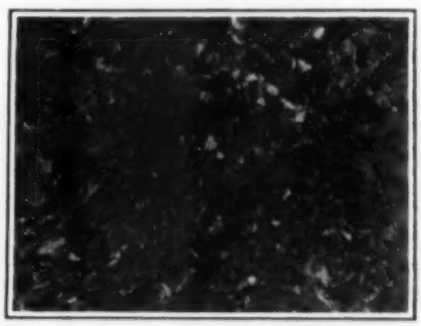


Fig. 1—Cast iron as poured magnified 200 diameters

are made by the company in 6 break-off sections, each section weighing 1 lb. The bars are added to the iron as it is being poured into the ladle from the cupola. First, a small amount of iron is run into the ladle, then a bar or more is added progressively as the ladle fills, in order to promote thorough mixing. The re-

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sulting loss of heat is said to be negligible.

Varying amounts of nichrome content in the castings have varying effect, principally on the Brinell hardness, which shows progressive improvement as far as experiments have been carried commercially. The resulting greater density of metal and improved structure has had no ill effect on its machineability. The

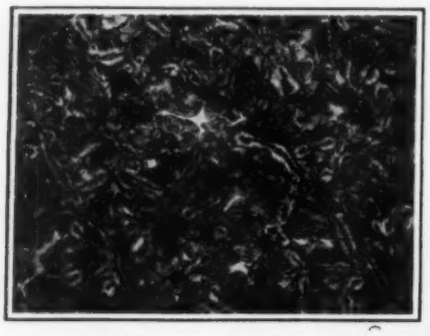


Fig. 2—Nichrome Bearing Cast iron

following tabulation of Brinell results are taken from an actual tested run:

Nichrome per cent	Brinell
0	207-217
1	212-228
2	223-235
3	241-255

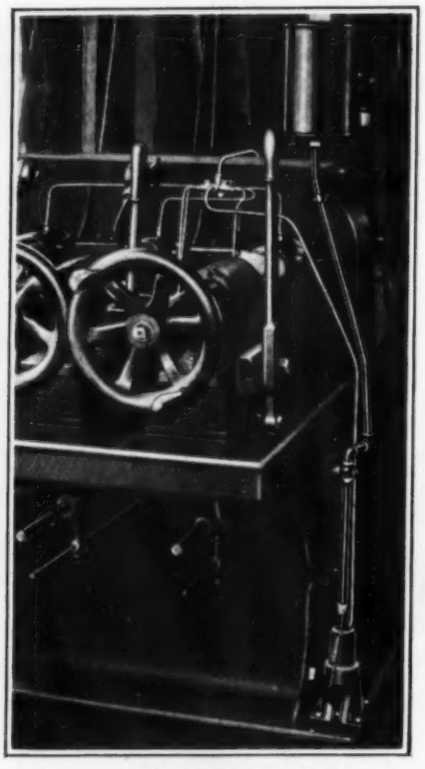
The company is not pushing the sale of its metal for the purpose, but stands prepared to furnish assistance on test runs.

Bowen Industrial Lubricating System

The system of lubrication which was originally developed by the Bowen Products Corporation, for use in connection with automobile and truck chassis, has been adapted by the company to the industrial field and is now being marketed for application to machinery such as is illustrated.

The apparatus consists of an elevated reservoir for the oil, a foot pump for setting up a positive flow, a manifold to act as a central distribution point and piping between reservoir, pump manifold and bearings.

The pump is mounted in any convenient position on the floor-section of the machine and is connected at its intake to the overhead reservoir. Its pressure outlet is, in turn, piped to the manifold, the location of which is determined by the machine layout. This manifold has as many controllable outlets as there are bearings to oil, each outlet being



Bowen Industrial Lubricating System

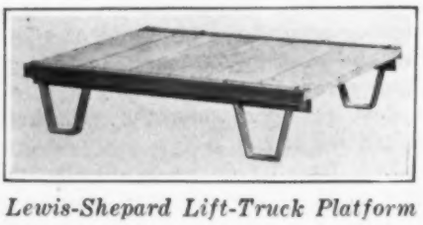
individually connected with one bearing. A pressure of the foot on the pump lever is sufficient to send a flow of lubricant to each point of use.

In order to assure clean oil in the system, a strainer is set into the top of the reservoir and is made detachable for cleaning purposes. No provision is made for returning oil after it reaches the bearings.

Lewis-Shepard Lift-Truck Platform

The Lewis-Shepard Co., Watertown Station, Boston, Mass., has added the lift-truck platform illustrated to its other lines of material-handling equipment.

The construction of upper and



Lewis-Shepard Lift-Truck Platform

lower angles is similar to that used in freight cars and in general heavy-service vehicles, the location of the bottom angles permits of clamping to steel surfaces on both sides of the wooden platform to keep the boards from working loose. The heavy strap-iron feet give a flat floor bearing.

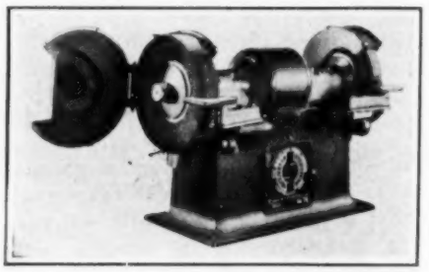
Standard tops for loads up to 3,000 pounds are 1¼ inch hardwood, birch, oak or maple. The thickness is increased to 1¾ inches for loads up to 5,000 pounds. Flat head, ½-in. bolts, setting flush with the top, are used in standard construction. Lockwashers are included.

When specified the boards can be mortised to make the top flush with the angles. The platform measures 31 in. in width by 38 in. long as a standard.

Sterling Grinder, No. 7-E

The Sterling grinder illustrated, is being put on the market by the Cleveland Stone Co., Cleveland, Ohio, for foundry and for general grinding purposes where a large-size wheel is required.

The machine mounts two wheels that can range in diameter between 20 and 30 in. and that can vary in width up to 4 inches. The shaft, which measures 2½ in. at the wheels



Sterling Grinder No. 7-E

and 3¼ in. at the center, rides in S. K. F. bearings and forms the rotor shaft for a 10-hp., 900-r.p.m., Lincoln motor mounted at the center on the top of the column. The grinder can be applied for operation from either 220- or 440-volt alternating current and is controlled by a push button or a hand-operated compensator as specified.

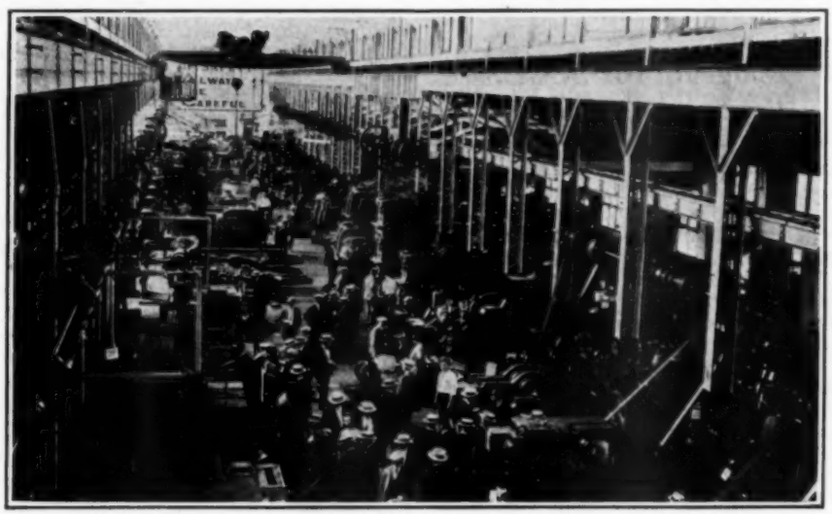
The wheel guards are hinged on the ends for access to the wheels and are provided with outlets at the bottom for attachment to an exhauster system. The work-rests are secured in place by two bolts.

News of the Week

Forging Machinery Exhibit Offers First View of New Equipment in Operation

Hundreds attend second exposition of the National Machinery Co.

Encouraged by the success of its first exposition in 1924, the National Machinery Co., of Tiffin, Ohio, staged a second and larger exhibit on Aug. 24, 25 and 26, with two extra days for the Blacksmith's Association and for a special trainload of visitors from Detroit. Only those who attended can appreciate the time and thought expended in making the plans or the care taken that each visitor was a guest in every sense of the word. Hospitality was the watchword and no detail was overlooked to make the visit both enjoyable and instructive.



Looking down the main bay from the bolt and nut plant

There were 62 machines on exhibition, all running and put into production whenever the visitors desired. Some, on smaller work, were in operation continuously on production schedules. With such a large number of machines on exhibition, it is obviously impossible to do more than mention some of them briefly. Some of the latest machines will be described in detail a little later.

Initial Showings

The exposition contained several machines that have not yet been offered for sale and some of them were shown for the first time. In addition to the machines there were 10 furnaces and 550-hp. in motors, about $450,000 worth, including the forging machines. Radical changes in design have enabled the speeds of some of the forging machines to be greatly increased. The ½-, ⅝- and 1-in. semi-hot continuous, automatic-feed bolt and rivet headers were particularly interesting. One size took the steel wire from the reel, ran it through a furnace and into the forging machine so that 200 bolts per min. dropped into the pan, ready for threading in the next operation.

Another bolt header was fed with blanks heated in a new automatic electric heater and made bolts with two blows that formerly required three blows to produce the same quality. Near this was a new bolt-head trimmer that trims the flash from square and hex-head bolts automatically, as they come from the forging machine.

Bolt threading machinery of various kinds was also in operation. This group included bolt cutters, with automatic opening dies, machines for putting the gimlet point on lag screws and for cutting the threads, as well as thread rolling machines of the vertical type. There were nut toppers from the bent-top automatic tappers for small nuts to the hand fed but semi-automatic, multiple-spindle machines for nuts up to two inches.

Forging machines of the heavier type were also in operation, producing large connecting rods with an excellent finish and an almost unbelievable amount of metal gathered into the large end for the main bearing. In addition, there were several hundred samples of forging machine work from airplane engine cylinder blanks to trolley pole holders, and many other varieties, both larger and smaller in size.

Besides the exhibit of forging machines in various stages of manufacture that gave a good opportunity to show just how they were made and the kind of workmanship that goes into them, there were a number of machines with the parts beside the frame so that the visitor could see the way in which the slides, cams and levers function and also the sizes of the bearings and slides used to perform the work. Some of these were carefully mounted on stands that held them in the approximate position they assume in the machine and

A battery of high-duty forging machines in operation

made the operation clear to everyone.

Those who planned the various details are to be congratulated on knowing what visitors are interested in and on knowing how to stage the various features effectively and interestingly. Men with "National Representative" met you at every turn and with unfailing courtesy told you what you wanted to know, or found someone who could.

Tiffin was literally flooded with visitors, far exceeding expectation, but all were provided for with little delay. Practical and responsible men from prominent railroads and large manufacturing concerns were much in evidence and the National Machinery Co. must feel satisfied that their second exposition was an unqualified success.

Producers Ask Higher Duty on Tungsten

Application has been made to the U. S. Tariff Commission on behalf of owners of domestic tungsten properties for the 50 per cent increase in the duty which the President could grant under the flexible provisions of the act. The probabilities are that the Commission simply will report the essential facts surrounding this metal to the President, leaving it to him to draw his own conclusions. Knowing the President's friendly feeling for high tariff schedules, the domestic producers are confident that he will allow the full increase.

The present duty on tungsten is equivalent to $7.14 a unit. The domestic producers contend that this will not allow them to operate. They will be able to point out that two domestic producers, during the past year, have made actual efforts to operate but were forced to close their mines. The average price of tungsten at that time was around $10. If the increased duty were granted it probably would insure a price of at least $15 under the present conditions.

War-time stocks now have been depleted to the point where tungsten again is being imported in quantity.

The domestic producers feel that this is an opportune time to secure an increase in duty. So long as large stocks were in existence they could have been prevented from enjoying the full benefit of the higher duty.

It is true that one domestic property is operating under the present duty, but this is declared to be possible because of a favorable lease which does not allow any amortization of the large capital expenditures in equipping and developing the property.

Tractors for Peasants

The foreign trade bureau of the Ukrainian Soviet Republic has announced that it will purchase 3,000 tractors during the current year for resale to the peasants, according to advices received from Kharkov by the Russian Information Bureau in Washington. Of this number 1,500 had been received by the middle of July. The tractors are being sold to the peasants on credit terms extending over a period of three harvests.

To Organize National Foremen's Club

T. B. Fordham, president of the Ohio Federation of Foremen's Clubs, has issued a call for a meeting of delegates from the various city foremen's clubs, and inviting any other persons interested, to meet at the Y. M. C. A., at Dayton, Ohio, on Oct. 8 at 10 a. m. to form the National Association of Foremen.

The rapid growth of foremen's clubs in many cities all over the United States, coupled with the keen interest of both the management and the foremen in the subject of better formanship, has made desirable the expansion of the Ohio Federation to take in clubs and individuals outside of Ohio. About 1,500 men attended the second annual convention held last May and many new clubs are to be formed this September. Any factory foremen's club, and any organization or persons interested in raising the standard of foremanship, are cordially invited to be represented at this meeting.

Program for S.A.E. Production Meeting

The program for the production meeting of the Society of Automotive Engineers, which will be held at Cleveland, Sept. 14 to 16, has just been completed. Five sessions on automotive production subjects have been scheduled.

The First session, on Monday afternoon, will be devoted to sheet-steel fabrication. The subjects and the speakers are:

Hot Stamping Methods—G. F. Keyes, Mullins Body Corporation. *Sheet-Steel Fabrication*—Syd Smith, Studebaker Corporation of America.

TRAINING SESSION:

Training of Mechanics for Production Work—Mrs. Lillian M. Gilbreth, Frank Gilbreth Co., Inc. *Foreman Training and the Value of Conferences*—F. T. Jones, White Motor Co. *The Training of Shop Foremen*—Louis Ruthenburg, Yellow Sleeve Valve Engine Works, Inc.

The second session, in the evening, will be an inspection of the National Steel Exposition. Tuesday morning the gear production session will hear two papers—*Coordinating Designs and Production Methods in Gear Development*, by P. L. Tenney, Muncie Products Division, General Motors Corporation, and *The Problem of Gear Production*—Earle Buckingham, Niles-Bement-Pond Co.

On Tuesday afternoon the machine tool session will be held. The papers and speakers will be: *Machine-Tool Needs of the Automotive Industry*—R. M. Hidey, White Motor Co.; *Machine-Tool Selection*—W. G. Careins, Ajax Motors Co.

Another machine tool session will take place on Wednesday morning with the presentation of these papers: *Machine-Tool Applications to Automotive Production*—A. R. Kelso, Continental Motors Corporation; *Jigs and Fixtures in Automotive Production*—J. Gustaf Moohl, Cleveland Automobile Co.

In the afternoon the members will listen to two discussions on inspection methods. The speakers will be: C. J. Ross, of the Buick Motor Co and J. J. Feeley, of the Glenn L. Martin Co.

The production dinner will take place on Tuesday evening and the grand ball in conjunction with the American Society for Steel Treating will close the convention on Wednesday evening.

Hoover Favors Combines in Foreign Trade

With the approach of another session of Congress, Secretary Hoover has renewed his plea for some form of counter action against foreign monopolies which exact unreasonable profits from American consumers. Extension of the Webb-Pomerene laws to imports so as to allow American buyers to present a solid front to a foreign combine is regarded by Secretary Hoover as the most practical step that could be taken, but he makes it clear that he will go along with any other proposition calculated to get results. He feels, however, that when Americans, because of manipulation are forced to pay and additional $82,000,000 in a single year for coffee alone, self defense in some form should be forthcoming.

Automotive Exports Show Big Gain This Year

Automotive exports from the United States during the first half of 1925, amounting to $185,000,000, not only exceeded the figures of the corresponding period of 1924 by over $65,000,000, but suggest a record figure for the full year trade, according to the automotive division of the Department of Commerce. This half-year figure is almost three-fourths of that of the entire year of 1924, when our total foreign shipments of this commodity approximated $252,000,000, and it has only to maintain this rate during the second half of this year in order to exceed by a comfortable margin the record figure of 1920.

Commercial Landing Field Planned in Atlanta

Announcement was made last week that Cornelius Vanderbilt, Jr. and associates had purchased 11,000 acres of land near Atlanta, Ga., on which will be established the third largest commercial air base in the country.

Mr. Vanderbilt, who is a member of the Research Council of the National Air Transport Co., is quoted as saying that the group interested with him in the project represents the leading engineering and financial interests of the country. Development of the plans will require about five years and will involve the expenditure of several million dollars. Facilities for handling dirigibles as well as airplanes will be provided. Atlanta will be used as a center for lines which will run West by New Orleans and South through Florida to Cuba. Three separate fields, each a mile square, will be constructed. Planes will carry freight, express and mail, but no passengers.

Engineers Recommend Patent Office Changes

The increase of the technical staff at the Patent Office by 100 is essential to placing the work there on a more satisfactory basis. A recommendation to that effect has been approved by the Committee on Patent Office Procedure. The proposal came originally from the sub-comittee composed of L. W. Wallace, W. H. Leffingwell and Wallace Clark and was approved by the full committee. The sub-committee also recommended changes in the conduct of the work which will make possible a reduction in the clerical staff and an improvement in the quantity and quality of the work done. The full committee adopted practically all of the recommendations of the sub-committee of engineers.

An administrative assistant for the Commissioner of Patents is proposed, which will make it possible for the commissioner and assistant commissioner to devote their entire time to their judicial duties.

More attention to the classification division is urged. Thirty-five or forty additional examiners should be assigned to that work at once, the report says. The report shows that the present method of procedure is so involved and present equipment is so nearly obsolete that these drawbacks must be removed before improved conditions may be expected.

New Tariff Benefits Shippers to Germany

Approval by the Reichstag of the commercial treaty which was ratified by the U. S. Senate in January, has an important bearing on our foreign trade with Germany, Secretary Hoover points out. While the United States has been accorded most-favored-nation treatment by Germany, it has been by courtesy only. We now are in a position to demand that treatment as a matter of right. The fact that we are assured against any sudden withdrawal of that privilege means much to those who ship goods to Germany.

Secretary Hoover thinks the new German tariff is not as formidable as it looks. Some of the schedules are due for material reductions at an early date under the flexible provisions of the law.

Ford Will Develop All-Metal Airplanes

The Ford Motor Co. became a manufacturer of airplanes on July 31 by purchasing all stock and assets of the Stout Metal Airplane Co.

The building of Stout all-metal planes will henceforth be carried on by the Stout Metal Airplane Division of the Ford Motor Co. Operations will be continued in the factory building at the Ford Airport, Dearborn, where four planes have already been built and others are under construction. William B. Stout, who developed the present model after fifteen years of experimentation and was a pioneer in building an all-metal monoplane of the thick-wing type, remains in charge of the plane manufacture while the personnel of expert engineers and mechanics also have been retained.

The Stout plant and manufacturing equipment were purchased by the Ford company for the purpose of accelerating airplane development by backing the work with the diversified resources and experience of the Ford organization. The scope of experimental operations will be widened while manufacture of the present type, which has proved highly successful in Ford air freight service, will be continued on a larger scale.

The association of the Stout Metal Airplane Co. with the Ford organization began less than a year ago when, on completion of the airplane factory building at the Ford Airport, in October, Henry Ford and Edsel Ford contributed their facilities to the development of the Stout plane, of which only one of the present type then existed. The Stout plane was selected because it appealed to Mr. Ford as the most logical, dependable and safe.

Navy Machine Shops Assured Steady Employment

The Navy Department has practically completed a program for the Washington navy yard which will insure its present force of employees work for two years, it was announced last week.

The program has been in process for many months by department officials in collaboration with Rear Admiral Benjamin Franklin Hutchison, commandant of the yard. Admiral Hutchison has advocated a program of steady work since he took charge of the naval gun factory at a time when it was getting back to a normal basis after the war. He told officials at that time that assurance of steady work over a given time, preferably two years, was necessary to keep up the morale and productive ability of his workers.

At the present time there are 2,339 employees in the Washington yard and there will be but a handful of these dismissed, if any at all, before the program is applied. After that the men won't have to worry about their jobs for two years.

At present there is sufficient work on armaments for the new authorized cruisers to keep the present force busy. In order to conserve the force of trained workers, the navy is making much of the materials it otherwise would buy. The work is now in the casting and forging shops and with the work outlined in the two-year program will furnish a steady flow of work for machinists beginning in a few months.

Navy yards as a whole are doing little work compared with prewar days. The situation is such that the Navy Department is prepared to close many of them if any further economy is forced upon it by the budget bureau.

The Washington yard, however, is not a navy yard, but a gun factory. It is busy with replacement guns and new linings for guns of the fleet.

Farm Machinery Shown at British Exhibit

The eighty-fourth annual exhibition under the auspices of the Royal Agricultural Society of England, was held at Chester from July 7 to 11. This exhibition was devoted largely to the display of agricultural implements, machinery and appliances. It was international in character as the exhibits included the products of foreign firms represented in the British market, as well as the products of British manufacturers. Agricultural implements were shown at 438 stands and they comprised about one-half of the total displays. The attendance at the exhibition was exceptionally good, and the number of foreign visitors, chiefly from Europe, was large. American visitors were not very numerous.

The exhibits of implements included practically all types used on British farms, but particular attention was given to agricultural transport and the use of power on the farm. A wide range of motor and steam driven appliances was shown which included tractors, traction engines, road locomotives, motor and steam rollers, cable plowing windlasses, steam vehicles particularly suited to the needs of the farmer, power lawn mowers, and farm lighting sets. Many of the tractors shown were fitted with special cultivators and harvesters. Nearly forty makes of gasoline and kerosene engines were shown. Full lines of cultivating and harvesting machinery were shown and included plows, harrows, hay-loaders, mowers, and reapers.

Representatives in charge of the exhibit stated that orders booked at this exhibition exceeded those of any previous year since the war. This reflects the improved condition among British farmers in general and shows the effects of better crops in 1924 which placed more money in the hands of the farming community.

July Exports of Machinery Almost Double

Exports of metal-working machinery for July, with revised comparative figures for July, 1924, as compiled by the Department of Commerce, are as follows:

	July, 1924 Value	July, 1925 Value
Lathes	$141,192	$245,423
Boring and drilling machine tools	74,381	69,268
Planers, shapers and slotters	24,468	28,905
Bending and power presses	23,791	78,882
Gear-cutting machines	27,299	105,803
Milling machines	40,271	105,406
Thread-cutting and screw machines	43,075	63,511
Punching and shearing machines	6,206	31,754
Power hammers	20,175	34,531
External grinding machines	71,270	148,429
Internal grinding machines	19,637	73,898
Other grinding and sharpening machinery	46,279	59,697
Chucks for machine tools	13,357	30,685
Reamers, cutters, drills, taps, dies and other metal-working tools	148,260	309,841
Pneumatic portable tools	62,731	112,255
Foundry and molding equipment	49,099	39,070
Other metal-working machinery and parts of	294,535	573,270
Metal-working machine tools (total)	$1,106,026	$2,110,628

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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DURING the last two weeks of August New York is filled with visitors from the West and South. Talking with them one's optimism is reinforced, for nearly all of them are optimistic about the country as a whole and their own localities in particular.

The improvement in the farmers' condition is the keystone of their confidence and, as one of them put it, every man, woman and child in the Middle-West will have a flivver if they can get present prices for their grain crops.

To argue with a cheerfulness so universal and so infectious is futile and moreover it would be wrong to disturb it unless it was obviously unwarranted. The economists may say what they please about the index numbers and the balance of trade and the bank reserves but prosperity, like Boston, is largely a state of mind, and as long as people are cheerful it will be difficult to persuade them that they are in any peril.

No doubt we will have a depression sooner or later but "On with the dance, let joy be unconfined" seems to express the present mood and to combat it would be ungracious as well as inexpedient.

But candor should not be forgotten in taking counsel of expediency and it is therefore in order to point out that the stock market is in a highly manipulated and artificial condition despite the apparent strength, that the demand for bonds continues to slacken, that the commodity markets lack initiative, and that the trade boom predicted for autumn has not yet arrived. Distributive business is good but not abnormally active.

Perhaps the truth is that the commercial leaders of America have been abundantly cautioned against the dangers of inflation and are trying to avoid them. If this is the case, then forewarned is forearmed, and we may escape the consequences that would otherwise follow the recklessness recently exhibited in the stock market.

As our cotton exports are largely responsible for what is called our favorable balance of trade it is at least reassuring to notice that they are already running ahead of last year and that, despite the larger crop estimates now current, Europe seems willing and able to buy freely as the market declines. This would seem to make any serious drop in the price of cotton unlikely, and that means much to the already prosperous South.

The wheat market is already beginning to feel the influence of the early spring wheat movement and, with a less active mill demand, prices sagged to lower levels. There is less confidence among traders over the prospect of $2 wheat in the near future as the unwillingness of Europe to show alarm over the available supply becomes more apparent to local interests.

What's Doing in Industry

Considering reports from all the important industrial centers of the country, there seems to be a slight stirring up of buying activity. The quietness of the earlier part of August has given way to a more brisk demand for machines, mostly of the special one-purpose design. While individual orders are not large, the total volume presents a very satisfactory figure.

Cincinnati and Detroit continue to report better business, the former getting a fair amount of the current railroad orders, while the latter thrives on the increased business afforded by changes in automobile plants.

The Chicago market reports an increase in inquiries, with a slight advance in railroad buying. In Milwaukee buying has been slow, but market conditions indicate that many orders will be placed in the next few weeks.

The South has had a busy summer season, with general industrial prosperity that is expected to bring future orders for new equipment. Philadelphia reports a favorable condition, with orders confined to small pieces from scattered locations. New York has received a few substantial orders, but this market is more interested now in the inquiries which forecast better business in the next few months.

It is generally believed that industrial leaders are aware of possible inflations and are taking the necessary means to check too rapid advance in business progress.

The news from industrial centers is generally encouraging. The iron and steel trades, after whistling for the wind during the past month, have apparently found something substantial on which to base their hopes. Steel production has risen to about 73 per cent of national capacity although price quotations are somewhat weaker. Imports of iron and steel in July totaled only 64,542 tons, the lowest in almost nine months, and 22 per cent smaller than the June total.

Copper failed to hold the recent advance to 15 cents and prices sagged back a quarter of a cent a pound. Lead and zinc, however, were generally firm all through the week.

Freight car loadings continue with almost monotonous regularity to break previous records, and the Federal Reserve Board reports a production of basic goods 20 per cent above the low level of a year ago. Automobile manufacturers were relieved to know that Ford is contemplating no price cut in the near future, but will confine his efforts to style improvements in his 1926 model.

Although business is apparently unconcerned about the impending coal strike, the likelihood that it will occur is shown by the recent stiffening in coal prices. Independent operators have raised their quotations on anthracite by 50 cents a ton, and soft coal prices are also firmer. The so-called "gasoline war" continues unabated with price slashes reported in all parts of the country. Perhaps the automobile owner will find compensation in cheap gasoline for the existing high cost of tires. Rubber prices, after a period of temporary stability around 80 cents a pound, were stronger again, spot sheets reaching 85 cents.

The outstanding news from Europe is the reported agreement of England and France on a settlement of the French war debt. The terms of the agreement contemplate an annual payment by France of approximately $61,000,000 for a period of 62 years. The final acceptance of this agreement hinges on the willingness of the United States to grant similar terms to France, and it is felt that Great Britain has placed this country in a difficult position by agreeing upon such lenient terms of settlement.

The United States cannot, of course, continue forever to be the world's chief exporter of goods, reservoir of capital and dispenser of credit all at the same time. But our position, unless endangered by reckless inflation, is one of dominant power, not of weakness. If the changes which apparently must come in our balance of trade can be accomplished gradually, and without sudden disruptions, we should be able to face the future with confidence.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Milwaukee

While current business in metal-working equipment continues to be only of a moderate volume, there seems to be substantial basis for hopes that the coming months will bring out a much more satisfactory quantity of orders and that the winter season will be an active one for most manufacturers of tools and machinery. The only drawback seems to be that the majority of machine shops have not yet been obliged to push their existing capacity to its limits.

Although it was believed that the bulk of buying by the larger automobile manufacturers was over, an active inquiry is present and each day reveals an order of fair size. Usually these embrace but one or two items of special equipment, but the total is mounting and the prospects are that the purchasing will continue well into the winter months, if not into next spring, when production will be stepped up sharply to meet seasonal demands for passenger cars. Announcement of new models and the general reduction in selling prices has stimulated the demand to a point far above earlier expectations and the fall operating schedules of most factories probably will be much heavier than planned. This will have the effect of advancing buying that was dated for mid-winter.

The A. O. Smith Corporation of Milwaukee, manufacturer of automobile frames, forgings and stampings, has been buying machinery for the automotive division as well as for a new division in the oilwell equipment field. Preparations are now being made for a material expansion of the large plant to handle this business.

Local tool manufacturers expect to derive some business from the list to be purchased by the receivers of the Chicago, Milwaukee & St. Paul Ry. This appears to be the best prospect in the railroad line in the Mid-West at present. Other railroads have been making piece-meal purchases, restricting orders to items most urgently needed.

Demand for used tools is fair as regards the lighter equipment. Heavy tools move very slowly, for despite the attractive level at which they are priced, buyers seem to prefer new machines of more advanced engineering. The used tool market some time ago was relieved of the heavy pressure of the inflow of stocks of concerns in liquidation, but disposition by dealers has not progressed at a satisfactory rate.

Cincinnati

Cincinnati machine tool manufacturers state that business conditions have improved materially in the past week and freely predict that there will be an increase in demand from now on. A number of orders that have been pending for some time have been closed in the last few days, it is stated, and other deferred orders will be closed soon.

Stocks of machine tools have been permitted to reach a low point, and a few manufacturers are taking steps to increase the number of tools on hand, in anticipation of a larger demand. It is pointed out that even a slight increase of fall buying will absorb such stocks as there are at present, and therefore if the increased demand is large some purchasers will have to wait until tools are made.

Railroad buying has shown a slight increase in the past week, and it is commonly believed that orders from this source will be larger in size and more numerous from now on. Inquiries from railroads are coming in freely. Numerous orders have come from the automotive industries, the majority of these being for replacements.

General machinists are gradually becoming busy, as the buying from this source has for some time been almost entirely confined to replacements.

A few good orders are reported to have come from the Pacific Coast in the past week, and a few orders were received for export, Germany being the principal buyer.

New York

Conditions have not changed appreciably in this market in the past week or ten days. Probably the most important feature of the present trend is the generous increase in the number of inquiries that have appeared. Buying has not been particularly active, due more to the height of the vacation season than to any lack of necessity for tools and shop equipment.

The month of August in its entirety has not equalled July when volume of orders is considered, but it is the opinion of dealers that the market has developed a most encouraging trend and a good fall business is looked for in all lines of machinery.

Railroads have placed a fair amount of business in the past week, and a new inquiry from the Lehigh Valley is expected to bring orders early in September. The Atchison, Topeka & Santa Fe purchased two axle turning lathes; the Chicago, Rock Island & Pacific, a 3,400-lb. steam hammer; the Leonir Car Works, two 10-ton traveling cranes; the Union Tank Car Works, a large axle turning lathe; the New York Central R.R. is looking for several pieces of shop equipment. Other buyers were the General Electric Co., the New York Edison Co, and the New York subway systems.

Detroit

Measured by the heavy sales of machinery and machine tools in the Detroit district during the past two months the present demand of manufacturers for tools and equipment shows a slight decline. The consensus of opinion, however, among representatives of machinery and machine tool firms is that business will be brisk for the next two months. Heavy production of automobiles by most of the leaders is assigned as the principal cause for this feeling.

While speaking generally there is a slight decline in sales, no one in the industry seems surprised, as this summer's business has been the best ever known. One leading dealer stated that with only ordinary luck he would do two months' ordinary business within the next week.

The Cadillac Motor Car Co., the Oakland Motor Car Co., and the Hudson Motor Car Co. are purchasing more equipment and tools than any other of the plants in southeastern Michigan just now. Orders for some big special machinery to be used in the manufacture of a new light "eight" which is expected to be announced around the first of the year are being placed by Cadillac. This machinery is of the heavier type and will take five or six months to make. Orders for smaller equipment have not been placed yet. Oakland is buying in fair quantities in preparation for the new line of cars which will be announced within a few months.

Continued swing from open to closed models on the part of motor car plants is proving an impetus to body builders. Fisher, Murray and Briggs are buying new equipment to handle increased demands for sedans, coaches and coupes.

One machine tool executive just back from a swing around the state reports that the general industrial condition in Saginaw, Bay City, Flint, Lansing and Muskegon is very good, with a fair market for machinery.

Philadelphia

Conditions accepted as favorable prevail throughout the Philadelphia industries, according to reports from numerous sources compiled during the week. Manufacturers of machinery and machine tools, for the most part, say that orders, while not extensive, indicate a sound condition in the industry, which portends a good business future. Buying now is confined for the most part to small purchases.

Manufacturers of machinery and machine tools, and industrial leaders generally, were much interested in the announcement of the sale of the New York Shipbuilding Corporation to Swiss interests. The corporation's plant at Camden, N. J., opposite Philadelphia, will be utilized largely for the manufacture of electric locomotives, although the shipbuilding industry will be a part of the new concern's activities.

Chicago

An increased number of inquiries from industrial interests located in the Middle-West, and supplemental orders from railroads, constitute the principal feature in the machinery industry this week. Practically all the large handlers of machine tools report satisfactory trade conditions, and agree that the outlook for good fall business is undoubtedly favorable.

Dealers differ as to the amount of business which may be looked for from the automotive industry prior to winter, but are in accord in the expectation of a good demand from manufacturers of radio parts and sets, this industry showing continuous expansion. Taken as a whole the indications, as expressed by those who keep in close touch with the country's industries, are that the fall trade this year will exceed that of the same season in 1924.

Southern District

Machine tool and equipment sales in the Southeast have continued to improve the past two weeks, Atlanta distributors advising that business right now is the heaviest it has been in several weeks, with the outlook for fall sales exceptionally bright.

Sales have been particularly good to textile mills and railroad companies, and also are reported fairly good in the lumber and woodworking field. Textile mills have been enjoying steady improvement in cotton goods demand the past several weeks, and are buying equipment on a more active basis. Furniture industries in North Carolina are very active, and are buying equipment.

There seems to be little abatement in the demand for heavier equipment from the larger Southern railroads, and with several shop construction projects under way in various parts of the South right now, this business gives promise of holding up well for another two months at least.

Fair export volume also is reported from the Alabama territory, with Cuba and South American countries the primary buyers.

Regarded as a whole, the fall outlook is the best it has been in the past four or five seasons, as industrially the South is enjoying an excellent business.

What the Railroads Are Doing

In an official statement dealing with the proposed reorganization of the mechanical branch of the Boston & Maine system, Thomas F. Joyce, assistant to President Hustis, gave notice of several changes affecting the Concord workshops of the road. The statement declares that heavy repair work on locomotives, much of which has been performed in the local shops, will be contracted at Billerica because of the improved facilities there.

"Business conditions as well as the condition of the rolling stock generally have made possible a reduction in forces at all points on the system," the statement says. "The work of caring for light running repairs on the locomotives will continue to be made at Concord and the shop built in connection with the new engine house will be utilized for this purpose to a greater extent than at present. This work in the past has been cared for largely in the erecting shop at Concord and at engine houses other than Concord.

"Arrangements are being made to concentrate repair work on work train and other equipment, now being cared for at other shops on the system, in the old erecting shops at Concord. So far as possible steel freight car equipment repairs will be concentrated at Concord."

The New York, Chicago & St. Louis R.R. reports July surplus of $414,322 after taxes and charges, against $214,098 in July, 1924. Seven months' surplus totaled $3,332,275 against $2,355,393 in first seven months of 1924.

The Central of Georgia R.R. has announced the placing of orders for 1,000 ventilated box cars and nineteen locomotives. The cost of the new equipment is $2,750,000. The cars are being built by the Tennessee Iron and R.R. Co., of Birmingham, and the locomotives by the Baldwin Locomotive Works, of Philadelphia.

The Seaboard All-Florida Railway Co. has applied to the Interstate Commerce Commission for authority to construct a 100-mile line from West Palm Beach through Miami to Florida City and ninety-four miles of road from Fort Ogden to Labelle, Estero and Punta Rassa, through Fort Myers. To finance the project the company would issue stock and joint bonds of the Seaboard Air Line, the Florida Western and Northern R.R. and the East and West Coast Railway, aggregating $25,000,000, at 49.5 per cent of par.

The Baltimore & Ohio R.R. has ordered 1,500 tons of rails from the Carnegie Steel Corporation.

The Missouri Pacific R.R. system has acquired, through its subsidiary the New Orleans, Texas & Mexico, several small lines in Texas. The heads of this proposed system are carrying out their plans for building a great transportation machine in the Southwest. The small lines which have been recently acquired for the purpose of rounding out the mileage in Texas are: San Antonio, Uvalde & Gulf, 317 miles; Sugar Land Railway, 63 miles; Asherton & Gulf Railway, 32 miles; and Rio Grande Railway, 26 miles. With the addition of these small lines, the consolidated system is now nearly 15,000 miles in length.

The report of the Lehigh Valley R.R. to the New York State Public Service Commission for quarter ended June 30, 1925, shows a surplus of $3,473,150 after taxes and charges. This compares with $1,714,022 in the second quarter of 1924.

Surplus for first six months of 1925 totaled $4,801,966, as compared with $3,118,363 in first half of 1924.

The Florida East Coast has ordered ten Mountain type locomotives. These locomotives will have 26-in. x 28 in. cylinders and a total weight in working order of 318,000 lb.

The Texas & Pacific has ordered 750 gondola cars.

The Central of Georgia has ordered 1,000 ventilated box cars.

The Missouri-Kansas-Texas has ordered 1,000 single sheathed box cars of 50 tons' capacity.

The New York, New Haven & Hartford is inquiring for 35 multiple-unit passenger cars.

The New York, Ontario & Western has ordered one 73-ft. combination passenger and baggage gasoline-electric car.

Class I railroads on Aug. 7 had 238,474 surplus freight cars in good repair and immediately available for service, according to reports filed by the carriers with the car service division of the American Railway Association.

Germany Sells More Farm Machinery

German exports of agricultural machinery during the first four months of 1925 amounted to 15,529 metric tons, according to the agricultural implement division of the Department of Commerce. This was more than twice as great as the exports in the same period of 1924, and was also greater than exports in the first four months of 1913, which amounted to 13,004 metric tons. The value of implements exported in the first four months of 1925 was 14,371,000 marks, against 6,956,000 marks in the corresponding period of 1924 and 11,466,000 marks in that of 1913.

News of the Automotive Industry

Chevrolet Motor Car Co.'s August production will be approximately 49,500 cars against 42,204 for July. For September the company is planning to build 53,000 Chevrolets, an increase of 3,000 over the predetermined September schedule. Continued growth in Chevrolet sales emphasizes a corresponding condition in nearly all the General Motors units. Earnings situation resulting from this high rate of General Motors divisions sales is, of course, not open to public inspection, but bankers declare each of the divisions has exceeded the sales quota on which the new prices were based, and their deduction is that profits are running ahead of expectations.

Directors of the Motor Wheel Co. have declared a dividend of 50 cents a share on the common stock payable Sept. 20 to stock of record Sept. 10. This compared with a payment the previous quarter of 40 cents a share.

The Austin Motor Co., Ltd., London, one of the oldest automobile manufacturing firms in Great Britain, will be amalgamated with General Motors, Ltd., a Canadian-American Corporation, as the result of a deal announced last week. The negotiations began a fortnight ago, when a representative of General Motors approached the Austin people at their Birmingham works and an actual contract, which provides for the amalgamation of the two companies, was signed. The Austin company has a capital authorized at £5,000,000, of which £3,350,000 is issued, with an authorized borrowing power of £2,000,000. It is headed by Sir Herbert Austin.

Pierce-Arrow bus production for the first seven months of this year shows 71 per cent increase over the same period in 1924. Truck production for the same period was 100 units in excess of 1924.

The Ford Motor Co.'s plant in Mexico City is now turning out assembled cars and trucks for distribution in that territory. In all essential details the Mexican plant is similar to Ford plants in other foreign countries and in the United States. Present facilities permit of chassis assembly only; additional equipment is being installed for body building and enameling.

The Willys-Overland Co. has issued a detailed consolidated statement for six months ended June 30, 1925. Net profit after depreciation, interest, expenses of new models, federal taxes, etc., was $9,148,634, equal to $41.49 a share earned on 220,495 shares of 7 per cent preferred stock and after regular 3½ per cent semi-annual preferred dividend requirements, to $3.70 a share (par $5) earned on 2,264,644 shares of outstanding common stock. This compares with $2,781,692 after charges, but before federal taxes, or $12.61 a share on preferred and 88 cents a share on common in first half of 1924.

The Moon Motor Car Co. reports July net earnings, after all charges, of $187,274. "Third quarter's earnings are running close to $3 a share for that quarter," Stewart McDonald, president, states. "The reason for the increased earnings is due to the success of Diana models on which the company got into production in June."

Statement of the Fisher Body Corporation and subsidiaries, including Fisher Body of Ohio, for the quarter ended July 31, 1925, shows net income of $5,207,005 after depreciation, interest and federal taxes, equivalent after allowing for Fisher Body of Ohio Co., preferred dividends, to $2.10 a share earned on 2,400,000 outstanding shares of $25 par common stock.

New Ford models will be ready in September. Bodies are 7 in. longer and have been lowered. Closed cars are offered in colors. Closed cars have nickeled radiators; all models have nickel head-lamp rims. A stream line effect has been obtained by raising the radiator and lamps. Tudor sedan, coupe and open bodies are all steel construction. Chassis is lower but is practically the same as before, except for changes in transmission and braking. Gasoline tank on closed cars is under the hood. Fenders are larger on all models and steering wheel is larger and set lower. Probably the feature of the new Fords which will most interest buyers is that there will be no change in prices.

A Lansing dispatch says that Durant Motors, Inc., is maintaining an excellent production record this summer. Average daily output, since spring, has been over 225 Star cars.

July production of motor vehicles was 357,883 passenger cars and 39,211 trucks, of which 346,728 passenger cars and 37,431 trucks were made in the United States and 11,155 passenger cars and 1,780 trucks were produced in Canada, according to the Department of Commerce. Production of passenger cars in the United States for the seven months ended July 31, 1925, was 2,203,219, against 2,010,459 for the corresponding period of 1924.

Personals

ELMER E. CULLISON has been appointed a special representative for the Pratt & Whitney Co., of Hartford, Conn. He is located in Altoona, Pa. Mr. Cullison was formerly chief tool designer for the Birdsboro Steel and Machinery Co.

JOHN VON DER HEYDE, for the past several years general superintendent of the De La Vergne Machine Co., of New York, manufacturer of Diesel oil engines, has announced his retirement, effective September first.

F. J. O'CONNOR has been appointed assistant purchasing agent for the Chicago, Milwaukee & St. Paul Ry. He is located at Chicago.

ARTHUR JACKSON has been appointed representative in Ontario and Eastern Canada for the Gibb Welding Machines Co., of Bay City, Mich.

L. M. SCOFIELD has joined the sales organization of the Stocker-Rumely-Wachs Co., of Chicago. He was formerly with the Reed-Prentice Co., of Worcester, Mass.

C. W. LITTLER has been appointed chief engineer at the Aliquippa Works of the Jones & Laughlin Steel Corporation.

ERLE ORMSBY has been appointed chairman of the public works committee of the St. Louis Section, American Society of Mechanical Engineers.

R. H. MULCH has been elected vice-president and general manager of the Flint Motor Co. He was formerly general manager of the Chevrolet Motor Co., and also of the Durant Motors Co., of Canada.

FREDERICK WIERK has resigned as sales engineer for the SKF Industries, Inc.

JAMES M. TODD has been transferred to the engineering department of A. M. Lockett & Co., contracting mechanical engineers, and has been assigned to the New Orleans office.

GUY HUBBARD, for many years active in the machine tool industry, has joined the editorial staff of the American Society of Mechanical Engineers, and will be located at the headquarters in New York City.

WILLIAM THIEL, mechanical superintendent for the Winchester Repeating Arms Co., New Haven, Conn., has resigned. He was in the company's employ for over twenty years.

Business Items

The Cleveland Duplex Machine Co., of Cleveland, has been appointed to represent the American Broach and Machine Co., in the Cleveland territory.

The Pratt & Whitney Co., of Hartford, Conn., announces the removal of its San Francisco office to 917 Howard Street.

The Fafnir Bearing Co., of New Britain, Conn., has announced the acquiring of a new plant adjoining the present factory building on Booth St., in New Britain.

The American Cable Co., announces the appointment of Bruntons, Musselburgh, to handle its general line, including wire rope and fittings, in Scotland. The Dominion Wire Rope Co., of Montreal, is the new Canadian distributor. Other new distributors are: The Marion Machine, Foundry & Supply Co., Marion, Ind.; J. Shuman Hower, 106 Foster Bldg., Utica, N. Y.; the Contractors Equipment Co., 8 Steuben St., Albany, N. Y.; and John C. Louis, 221 S. Eutaw St., Baltimore.

The factory of the Goodell-Pratt Co., in Shelburne Falls, Mass., is being dismantled and the machinery moved to Greenfield and installed in the new plant there.

The plant, property and good-will of the Strom Ball Bearing Manufacturing Co. have been acquired by the Marlin-Rockwell Corporation. The business of the company will be conducted as heretofore under the direction of the same personnel and department heads. There will be no change in the policy or the conduct of the business. The same lines of bearings under the Strom trade name will be continued as at present. All correspondence should now be addressed to the Marlin-Rockwell Corporation, successor to Strom Ball Bearing Manufacturing Co., 4535 Palmer St., Chicago.

The North East Electric Co., of Canada, has been organized at Toronto and will soon begin the manufacture of starters, generators and ignition sets.

Obituaries

JOHN H. DALEY, mechanical superintendent of the New York, New Haven & Hartford R.R., died at Auburn, N. Y., on Aug. 28 after a brief illness. Mr. Daley's home was in West Haven, Conn.

CONRAD NORDFORS, mechanical engineer associated with the Walter Scott Printing Machine Co., died at his home in Plainfield, N. J., on Aug. 27. He was 54 years old.

Pamphlets Received

Comparative Cold-Rolling Tests of Open-Hearth Steel Strip (Deep Drawing Stock) and Electrolytic-Iron Strip. By John R. Freeman, Jr., and R. D. France. Published by The Bureau of Standards. Technological paper No. 288. This paper relates the results of a series of tests that were carried out to determine the relative cold-rolling properties of electrolytic iron as compared with open-hearth steel especially adapted for deep-drawing operations.

Simplified Practice for Milling Cutters. Published by the Bureau of Standards, Washington, D. C., Elimination of Waste, paper No. 36. Contains the simplified practice list of size and specification standards as adopted unanimously on Mar. 25, 1925, by the general conference of representatives of manufacturers, distributers and users of milling cutters.

Master Specifications. Published by the Bureau of Standards, Washington, D. C. Circular No. 263 on Cotton Waste, Colored. Circular No. 270 on Mercerized Cotton Airplane Cloth, Grade A. These circulars give the requirements as to grade, material and marking, and the method of inspection for the materials named.

Specifications for Screw Threads. Published by the National Screw Thread Commission, Superintendent of Documents, Washington, D. C. Price 35c. The edition published in 1921 has been extensively revised and rearranged, and several new sections have been added. The report contains specifications for bolts, nuts and commercial tapped holes; for a course and a fine thread series made in four classes of fit; specifications for threads of special diameter and pitch, fire hose, small hose and pipe threads; threading tools, tap drills and gages.

Tool Steel Trade Names. Published by the American Society for Steel Treating, as pages N-15 to N-24, of its handbook. This list gives the names of the principal manufacturers or agents handling tool steels and the trade names and grades of their products. There are two alphabetical lists, one arranged according to manufacturers, and the other according to the trade names.

Automatic Train Control Devices. Report of the Interstate Commerce Commission No. 13413. Printed at the Government Printing Office, Washington, D. C. This report deals with the installation of an automatic train control device of the Union Switch & Signal Co. on the first division of the Oregon-Washington Railroad & Navigation Co. After the inspection and test, the installation was found to meet the requirements of the commission and was approved except as indicated in the report. The report also lists some prescribed requirements in respect of certain apparatus and operations with which they expect the carrier to promptly comply.

Trade Catalogs

Electric Tools. James Clark, Jr., Electric Co., Louisville, Ky. Catalog No. 30 is 46-page booklet to cover the Clark electrically driven tools, including portable and bench drills, saws, grinders, motors and generators.

The specifications of each type are given and accompany the individual descriptions.

Foundry Equipment. Whiting Corporation, Harvey, Ill. A general catalog has been prepared in a letter-size, loose-leaf binder comprising catalogs Nos. 200 through 208. The equipment described in the general catalog includes cranes, cupolas, ladles, tumblers, core ovens, turntables, air hoists, converters and brass-foundry equipment, and the material makes a book of 208 pages bound in artistically decorated cloth-board covers.

Each section gives a general and a detailed description of the subject including illustrations and specifications and has also a collection of illustrations of installations of the Whiting equipment in many well known shops. The catalog on cranes, No. 200, has an especially large collection of photographs.

The catalogs are well-written and prepared, and the entire layout shows considerable care and thoroughness.

Electric Dumb Waiters. The Warner Elevator & Manufacturing Co., Cincinnati, Ohio, has issued bulletin F-18 to describe the Warner dumb waiter type F-18. Attention is called both to the winding engine and the control system.

Tool Steel. Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. The Ryerson Handbook on Tool Steel, by G. Van Dyke, has eighty pages, 5x8 in., board covers. The first half of the book is intended to cover the selection, the heat-treatment and grinding of tool steels. The discussion is in a non-technical and simple style, but the value of the handbook is not lessened thereby in any way. It is such information as the shop man should know and would find useful in handling his stock. This section of the book describes heating equipment, and the forging, annealing, quenching and drawing of tool steel. A few pages are devoted also to testing, heat measurement and grinding.

The second half of the book adheres to the usual style of similar catalogs. Full information is given as to the quality and grades of the Ryerson steels and tables are given of the weights and sizes in which the material may be had. Tables of information are given as to temperatures and colors, definitions of common terms and customs in ordering tool steel.

Milling Cutters. Goddard and Goddard Co., Detroit, Mich. Railroad Catalog No. 1 is devoted to special and standard milling cutters, particularly adapted to railroad shop work. The catalog includes sectional slabbing cutters, channeling and facing cutters, reamers and arbors. Tables are given of the cutter sizes, arbor and keyway sizes. Notes on milling operations are also included.

Forthcoming Meetings

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Ill., Sept. 2, 3 and 4. G. G. Macina, C. M. & St. P. Ry., 1402 Calumet Ave., Chicago, Ill.

International Railway General Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 8, 9, 10 and 11. William Hall, secretary and treasurer, 1061 W. Wabash St., Winona, Minn.

New Haven Branch of the American Society of Mechanical Engineers. Fifth annual machine tool exhibition. Sept. 8 to 11. Mason Laboratory. H. R. Westcott, chairman.

Association of Railway Supply Men. Annual convention and exhibition. Hotel Sherman, Chicago, Sept. 8, 9, 10 and 11. Earl E. Thulin, secretary, the Duff Manufacturing Co., 715 People's Gas Bldg., Chicago.

American Society for Steel Treating. Annual Convention and National Steel Exposition. Public Auditorium, Cleveland, Ohio. Week of Sept. 14. W. H. Eisenman, Secretary, 4600 Prospect Ave., Cleveland, Ohio.

Production Meeting Society of Automotive Engineers. Sept. 14, 15 and 16. In conjunction with American Society for Steel Treating. John Younger, chairman; C. F. Clarkson, secretary, 29 West 39th St., New York City.

Association of Iron and Steel Engineers. Annual convention and exposition, Commercial Museum, Philadelphia, Sept. 14 to 19. J. F Kelly, secretary, 513 Empire Bldg., Pittsburgh.

National Safety Council. Fourteenth annual safety congress, Cleveland, Sept. 28 to Oct. 2. A. A. Mowbray, director, 168 N. Michigan Ave., Chicago.

American Gear Manufacturers' Association. Semi-annual meeting, Oct. 1, 2 and 3, West Baden Springs Hotel, West Baden, Ind. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Annual meeting, State Fair Grounds, Syracuse, N. Y., Oct. 5 to 9. C. E. Hoyt, secretary, 140 So. Dearborn St., Chicago.

Motor and Accessory Manufacturers' Association. Fall meeting, Prince Edward Hotel, Montreal, Canada, Oct. 14 to 16. M. L. Heminway, general manager, 250 West 57th St., New York.

National Industrial Advertisers' Association. Annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., Oct. 19 to 21. W. A. Wolff, chairman, the Western Electric Co., 195 Broadway, New York.

Management Week. Conducted jointly by five societies—The American Society of Mechanical Engineers, The American Management Association, The National Association of Cost Accountants, The Taylor Society and the Society of Industrial Engineers. Week of Oct. 19 to 24. W. L. Conrad, of the A. S. M. E., is chairman of the joint committee.

American Welding Society. Exposition of welding equipment and accessories, Massachusetts Institute of Technology, Cambridge, Mass., Oct. 21, 22 and 23. R. L. Browne, chairman, 141 Milk St., Boston, Mass.

American Society of Mechanical Engineers. Annual meeting, Engineering Societies Bldg., 29 West 39th St., New York City, Nov. 30 to Dec. 3. Calvin Rice, secretary, Engineering Societies Bldg., New York.

National Exposition of Power and Mechanical Engineering. Fourth annual event, Grand Central Palace, New York City, Nov. 30 to Dec. 5. Charles F. Roth, manager, International Exposition Co., Grand Central Palace, New York City.

American Association for the Advancement of Science. Annual meeting, Kansas City, Mo., Dec. 28, 1925, to Jan. 2, 1926. Burton E. Livingston, secretary, Smithsonian Institute Bldg., Washington, D. C.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Coal strike and higher coke prices causing firmness in pig-iron market; prices unchanged from Aug. 21 level for third quarter deliveries. Hot and cold rolled strip steel, bars and structurals in good demand. Plates are weakest of principal hot rolled products. Quotations range from $1.80 to $1.90 per 100 lb., Pittsburgh, for steel plates. Shapes and bars bring $1.90 to $2 at mills. Soft steel bars and cold finished shafting have not changed in price during past year at New York warehouses; bolts, nuts, washers, etc., are at prices prevailing seven months ago although general level is higher than at this time in 1924.

Non-Ferrous Materials—Prices unchanged from last month but higher than year ago in solder, cotton waste, abrasives, lubricants and belting. Fabricated brass higher than month ago or one year ago. Lard cutting oil has not changed during past year.

(All prices as of Aug. 28)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$23.05
Northern Basic	22.27
Southern Ohio No. 2	22.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	18.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.26
Virginia No. 2	29.17
Basic	21.16
Grey Forge	.....
CHICAGO	
No. 2 Foundry local	22.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.77
Basic	20.77
Bessemer	20.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.90@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.30@2.40	3.89	3.10	3.50
No. 12	2.35@2.45	3.94	3.15	3.55
No. 14	2.40@2.50	3.99	3.20	3.60
No. 16	2.50@2.60	4.09	3.35	3.70
Black				
Nos. 17 to 21	2.95@3.00	4.15	3.70	3.80
Nos. 22 to 24	3.00@3.05	4.20	3.75	3.85
Nos. 25 and 26	3.05@3.10	4.25	3.80	3.90
No. 28	3.15@3.20	4.35	3.90	4.00
Galvanized				
Nos. 10 and 11	3.20@3.25	4.35	4.10	4.00
Nos. 12 to 14	3.30@3.35	4.45	4.20	4.10
No. 16	3.45@3.50	4.60	4.35	....
Nos. 17 to 21	3.60@3.65	4.75	4.50	4.40
Nos. 22 to 24	3.70@3.80	4.90	4.65	4.55
No. 26	3.90@3.95	5.05	4.80	4.70
No. 28	4.20@4.25	5.35	5.10	5.00

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ½-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
½	$0.15	50%	⅞	$0.18	35%
⅝	.16	45%	1	.19	31%
¾	.17	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.30 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.00	....	4.00@4.65
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.05	....	....
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	8.25	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	3.80	3.60
Cold drawn flats, squares	4.65	4.30	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	60%

Electric welding wire, New York, 3/32, 8.25c.; 1/8, 7.85c.; 5/32 to 1/4, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound			
Copper, electrolytic (up to carlots), New York			15.00
Tin, 5-ton lots, New York			57.75
Lead (up to carlots) E. St. Louis	10.00	New York	10.75
Zinc (up to carlots) E. St. Louis	7.65	New York	8.50

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	18.00	20.00	....
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	20.25	17.00	16.75@17.00
Copper bars, base	21.87½	21.50	21.87½
Copper tubing, base	24.75	25.50	24.75
Brass sheets, base	19.12½	19.00	19.12
Brass tubing, base	23.75	23.75	23.75½
Brass rods, base	16.87½	16.87½	16.87
Brass wire, base	19.62½	22.50	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1–15 ton lots	28.00	28.00	28 03
Zinc sheets (casks)	11.25	11.50	10 75
Solder (½ and ½), (case lots)	39.50	38.00	38@42
Babbitt metal (83% tin)	60.00	69 25	58@63
Babbitt metal (35% tin)	28.00	20.50	30@35
Nickel (ingots) f.o.b. refinery	31.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	38.00	.....	.....
Nickel (shot) f.o.b. refinery	32.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.50@12.75	12.00	12.50@13.00
Copper, heavy, and wire	12.00@12.37½	11.75	11.75@12.25
Copper, light, and bottoms	10.00@10.37½	10.00	10.75@11.25
Heavy lead	8.00@ 8.37½	7.25	8.50@ 9.00
Tea lead	6.50@ 7.00	4.75	7.00@ 7.50
Brass, heavy, yellow	7.50@ 8.00	7.50	8.00@ 8.50
Brass, heavy, red	8.00@ 8.50	9.75	9.75@10.25
Brass, light	6.25@ 6.50	6.00	7.50@ 8.00
No. 1 yellow rod turnings	8.25@ 8.75	8.00	8.00@ 8.50
Zinc	4.75@ 5.25	4.00	4.50@ 5.00

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9 50
	Coke Plates—Primes.			
100-lb.,	14x20	6.50	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.25	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.18
Cotton waste, colored, per lb.	.10@ .15½	.18	.17
Wiping cloths, washed white, per lb	.17	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	1.08	1.14	1.08
Lard cutting oil, 25% lard, per gal.	.55	.50	.72
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40%	40%	30–10%
Heavy grade	30–10%	30–10%	30–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50–5%	50–10%	50%
Second grade	50–10–5%	60–5%	50-10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold finished shafting	per lb.	.0415	.0415	.0415
Brass rods	per lb	.1687½	.1587½	.1475
Solder (½ and ½)	per lb.	.395	.395	.385
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	50%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.00
Emery paper	10.71	11.00	11.90
Emery cloth	29.48	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.40
Cloth	3.55	2.67	3 55
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		2.90@3.00
Coke, prompt foundry, Connellsville	per net ton		4.00@4.50
White lead, dry or in oil	100 lb. kegs		New York, 15.75
Red lead, dry	100 lb. kegs		New York, 15.75
Red lead, in oil	100 lb. kegs		New York, 17.25

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%. Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.60@3.75 per 100 lb at Cleveland

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x⅜in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses; with hex. heads, $4.65 per 100 lb. net at Chicago.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x¼-in., 2c. each. Discount 70% for 5/16-in. and smaller and 65% for ⅜-in. and larger.
Case hardened ½x¼-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x2¼-in. to 4½-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, 7/16x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c., longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Conn., New Britain—Fafnir Bearing Co., Booth St.—machinery for proposed new plant.

Ga., Cuthbert—D. D. Dunn, Jr., Jacksonville, Fla.—machinery for manufacture of crates, to be installed in the Cuthbert Crate & Refrigerating Co. plant recently acquired.

Ill., Chicago—J. Ericson, City Engr., City Hall—coal and ash handling equipment, one 20 ton and one 7½ ton electric traveling cranes.

Md., Baltimore—The Kimball-Tyler Co., 261 South 8th St.—machinery for cooperage shop.

Mass., Boston—O. F. Farley, 27 State St.—miscellaneous tools and equipment for repair and service garage on Brighton Ave.

Mass., Chelsea (Boston P. O.)—Gordon & Gerber, 20 Sumner St.—equipment for metal working plant on Spruce St.

Mass., Roxbury (Boston P. O.)—T. J. O'Grady, 119 Conant St. — miscellaneous tools and equipment for repair and service garage.

Mass., South Boston (Boston P. O.)—Keystone Mfg. Co., 288 A St.—five 10 kw. electric spot welders.

Mich., Detroit—Dept. of Street Railways, St. Jean and Shoemaker Aves., F. Meyer Jr., Purch. Agt.—150 gross $\frac{8}{12}$ x 12 in. x 14 point 025 hacksaws.

Mich., Detroit—Wolverine Tube Co., 1411 Central Ave.—equipment for tube factory.

N. Y., Buffalo—Rome Wire Works, 56 Clyde Ave.—machinery and equipment for the manufacture of wire for proposed factory addition.

Tenn., Mooresburg — G. W. Bolinger — small band saw and wood planer (new or used.)

Wis., Portage — J. Henton, Highway Comr.—traveling crane.

Opportunities for Future Business

Ala., Bessemer—J. O. Heinze Cultivator & Tractor Co., plans the construction of a plant for the manufacture of tractors.

Conn., Danielson—Bd. Educ., F. E. Bitgood, Chn., plans the construction of a 2 story school including manual training rooms, etc. Estimated cost $150,000. Architect not selected.

Conn., Greenwich — Fletcher Thompson Inc., 542 Fairfield Ave., Bridgeport, Archt., will receive bids until Sept. 5th for the construction of a 1 story, 100 x 206 ft. sales and service station here, for Putnam Corporation. Estimated cost $100,000.

Conn., New Britain—Fafnir Bearing Co., Booth St., awarded contract for the construction of a 6 story, 60 x 165 ft. factory on Orange St. Estimated cost $200,000.

Conn., New Haven — H. W. Walker, Algonquin Road, Bridgeport, awarded contract for the construction of a 1 story, 150 x 190 ft. garage, shop and showroom on Davenport Ave. here. Estimated cost $175,000.

Conn., Waterbury—A. H. Wells & Co., 563 Watertown Ave., has had plans prepared for the construction of a 1 story, 100 x 145 ft. tube factory. Estimated cost $50,000. Private plans.

Ill., Granite City—Huff Motor Sales Co., 20th and Madison Sts., awarded contract for the construction of a 2 story, 100 x 100 ft. garage and showroom.

Ill., Rockford—Barber-Colman Co., River and Loomis Sts., awarded contract for the construction of a 2 story, 80 x 130 ft. tool manufacturing plant. Estimated cost $40,000.

Ill., Sterling—Northwestern Barb Wire Co., awarded contract for the construction of a 2 story, 80 x 140 ft. factory. Estimated cost $40,000.

La., Cedar Grove—Red River Lumber Co., Shreveport, plans the construction of a planing mill in connection with lumber plant, here.

Md., Baltimore—The Kimball-Tyler Co., 261 South 8th St., has had plans prepared for the construction of a 1 story cooperage shop on 8th St. Estimated cost $75,000. Stehl & Michel, 100 North Liberty St., Engrs. Noted June 25.

Mass., Boston—L. S. Kaufman, 43 Tremont St., will build a 2 story, 100 x 200 ft. garage and repair shop at Lehigh and Albany Sts. Estimated cost $200,000. G. N. Jacobs, 4 Park St., Archt. Noted July 30.

Mass., Boston—Margans, Inc., 755 Washington St., plans the construction of a warehouse and garage at 1022 Massachusetts Ave. Estimated cost $150,000. Architect not selected.

Mass., Charlestown (Boston P. O.)—Schoolhouse Dept., City Hall, Boston, is having plans prepared for the construction of a 1 story, 60 x 125 ft. wood and metal working shop here. Estimated cost $40,000. G. S. McLaughlin, 80 Boylston St., Boston, Archt.

Mass., Dorchester (Boston P. O.) — I. Cabitt, 6 Castlegate Road, Roxbury, plans the construction of a 1 story repair and service garage at 187 Washington St. here. Estimated cost $50,000. Architect not selected.

Mass., Dorchester (Boston P. O.)—Dept. of Public Works, 506 City Hall Annex, Boston, will soon award contract for the construction of a 1 story repair and service garage on Hancock St. here. Estimated cost $50,000.

Mass., Dorchester (Boston P. O.)—Skinner Organ Co., is receiving bids for the construction of a 2 story addition to factory at Sydney St. and Crescent Ave. Estimated cost $40,000. Monks & Johnson, 99 Chauncy St., Boston, Archts.

Mass., Everett (Boston P. O.)—Jackson Door & Window Co., 95 Canal St., Boston, is receiving bids for the construction of a 2 story addition to plant here. Estimated cost $40,000. Warren Engineering Corporation, 50 Terminal St., Charleston, Engr.

Mass., Lynn—J. S. Kaugman, 85 Newhall St., will build a 1 story, 110 x 140 ft. repair and service garage and salesroom. Estimated cost $75,000. Private plans.

Mass., Roxbury (Boston P. O.)—C. Martin, 43 Tremont St., Boston, is receiving bids for the construction of a 1 story, 40 x 200 ft. repair and service garage here. Estimated cost $50,000. Tuck & Co., 636 Warren St., Archts.

Mass., Rutland—Prescott's Bus Line, C. Prescott, Maple Ave., plans the construction of a repair shop, garage and terminal. Estimated cost $40,000. Architect not selected.

Mass., Somerville (Boston P. O.)—E. Stone, c/o F. A. Norcross, 46 Cornhill, Boston, Archt., awarded contract for the construction of a 1 story repair and service garage at 122 Broadway here. Estimated cost $100,000.

Mich., Detroit—Wolverine Tube Co., 1411 Central Ave., awarded contract for the construction of a 2 story factory. Estimated cost $50,000.

Miss., Laurel—McLeod Furniture Co., R. H. McLeod, recently incorporated for $100,000, awarded contract for the construction of a factory for the manufacture of hardwood products at Ellisville Blvd. and Laurel Sts.

N. J., New Brunswick — International Motors Co., Jersey Ave., awarded contract for the design and construction of a 2 story, 67 x 276 ft. addition to building No. 2 of its manufacturing plant to Stone & Webster Inc., 147 Milk St., Boston, Mass. T. F. Ryan, Supt. of construction.

N. Y., Albany—Standard Oil Co. of N. Y., 26 Broadway, New York, awarded contract for the construction of a 3 story, 150 x 170 ft. garage here. Estimated cost $200,000.

O., Akron—Mankin-Ferris Co., 422 West Exchange St., has had plans prepared for the construction of a 3 story, 76 x 130 ft. sales and service building on West Market St. Estimated cost $150,000. F. W. Striebinger, 1900 Euclid Bldg., Cleveland, Archt.

O., Cincinnati—The Roby Cigar Machine Co., M. E. Stern, 407 Keith Bldg., Dayton, Pres., recently incorporated, capital $250,000 plans the construction of a plant for the manufacture of Roby inventions here.

O., Cleveland — Bender Body Co., T. Kundtz, Jr., 6409 Barberton Ave., awarded contract for the construction of a 1 story, 150 x 360 ft. addition to factory for the manufacture of auto bodies. Estimated cost $150,000.

Pa., Philadelphia — Atwater-Kent Co., will receive bids until September 10th for the construction of a 1 story, 119 x 225 ft. addition to plant for manufacture of radios at Roberts Ave. and King St. Ballinger Co., 125 Chestnut St., Archt.

Pa., Philadelphia—Dodge Steel Co., State Road, plans the construction of a 1 story, 30 x 60 ft. shop. Estimated cost $5,400. Private plans.

Pa., Pittsburgh—F. D. Saupp, Inc., 5928 Pennsylvania Ave., is having plans prepared for the construction of a 2 story, 106 x 150 ft. sales and service building on Center Ave. Estimated cost $150,000. Eric Fisher Wood Co., Hardy Hays Bldg., Archt.

Pa., Philadelphia—M. F. Wilfong Iron Works, 52nd and Grays Sts., plans the restoration of a foundry to replace fire loss. Heacock & Hokason, 1211 Chestnut St., Archt.

W. Va., Huntington—Chesapeake & Ohio R.R., Marshall Bldg., Cleveland, O., awarded contract for the construction of a boiler shop here. Estimated cost $400,000.

W. Va., Huntington—A. J. Dalton, will receive bids about October 10th for the construction of a 5 story, 171 x 185 ft. garage on 5th Ave. Estimated cost $200,000. Meanor & Handloser, Archt.

Wis., Milwaukee — J. Obenberger Forge Co., 125 Barclay St., awarded contract for the construction of a 42 x 60 ft. forge shop.

Wis., Milwaukee — A. O. Smith Corp., 27th and Keefe Aves., awarded contract for the construction of a 1 story, 182 x 520 ft. plant for the manufacture of gasoline stills. Estimated cost $90,000. Noted Aug. 27.

Wis., Milwaukee—Wellauer Estate, 3324 Sycamore St., plans the construction of a 4 story plant to replace fire loss. Reichardt Automotive Supply Co., 91 Huron St., manufacturers of auto accessories, lessee. Estimated cost $40,000.

Wis., Portage — J. Henton, Highway Comr., awarded contract for the construction of a 1 story, 42 x 80 ft. machine shop. Estimated cost $20 000.

Ont., Stratford — Federal Combustion Corporation, recently incorporated at $200,000, plans to take over vacant premises and equip for the manufacture of oil burning equipment. W. J. Press, c/o owner, Engr.